ELECTRICAL REVIEW

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ELECTRICAL REVIEW

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13 JULY 1956

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117 *REGIONAL GUIDE TO ELECTRICAL CONTRACTORS*
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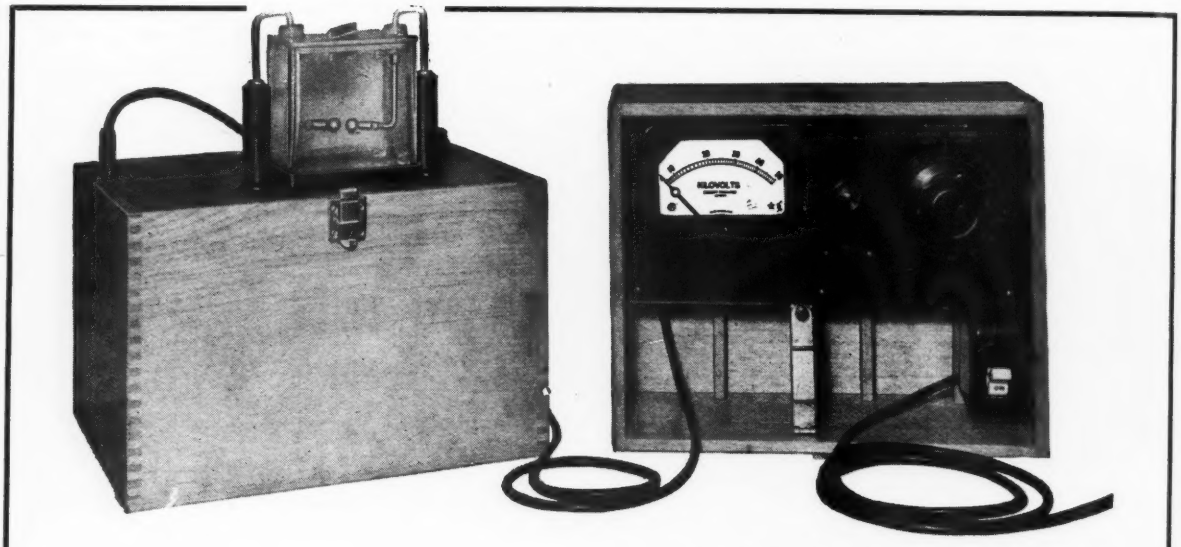

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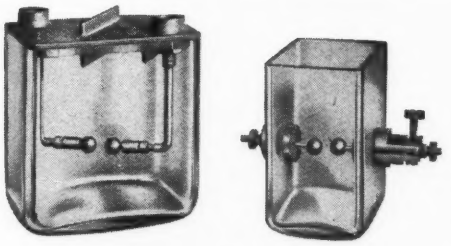

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Advanced Technology

EIGHT colleges have now been designated as colleges of advanced technology. In announcing this to the House of Commons recently the Minister of Education briefly indicated the qualifications which an educational establishment would have to possess before it was designated. These requirements are set out in a pamphlet issued by the National Council of Technological Awards.

A college seeking designation will be expected to provide a substantial programme of advanced studies, " conducted in an environment where advanced studies are the main pre-occupation of the staff." It will be expected to have good library facilities and good social amenities. Although absence of residential facilities will not, for the time being, debar a college from securing advanced technology status it will eventually be a condition of designation. This, it will be agreed, is very desirable, for a " collegiate " atmosphere is conducive to the sharpening of wits by the interchange of ideas.

Libraries, social amenities and housing are all matters of securing the necessary finance and there are indications that the Government and industry realise that the money must be provided. Not so simple is the securing of the high quality staff which is another, obvious, requisite for recognition. The National Council lays it down that the leaders in each branch of study should have either higher degrees and substantial academic experience or suitable academic qualifications supported by substantial industrial experience, or both. In fact just the kind of man which industry requires in its design and research establishments, which leads the National Council to say that it is highly desirable that colleges and industry should arrange their conditions of employment so that interchange of staff for suitable full-time periods can be encouraged.

This means that competition for technologists between industrial concerns and colleges must give way to co-operation between them and also that the staffs of the colleges must be at least as well paid as their confreres in industry. It seems as though a scheme will have to be worked out for putting the interchange upon a regular footing.

The pamphlet sets out concisely the nature of the courses which the colleges will provide and again emphasises the essential link between academic and industrial training. Either three-year full-time courses or " sandwich " courses lasting four years are specified. In the case of full-time courses students must spend at least a year in industry; this can be undertaken before the course or during it, or both. It is expected that there will be " flexibility " in the qualifications for admission and special tuition arrangements in the first year of a course to meet varied backgrounds of education. By this means it is hoped to attract a sufficient supply of students of the required standard, many of whom will eventually become teachers and thus help to solve the main problem —the provision of adequate qualified teaching staff.

ELECTRICAL INSULATING MATERIALS

For many years information on the classification of electrical insulating materials has been given in the appendices of those British Standards in which reference is made to the insulation of windings. Most of these appendices were based on the 1935 edition of the International Electrotechnical Commission's recommendations for rotating electrical machinery. The classification given in this publication came to be very widely adopted for all types of electrical machinery and apparatus, and for this reason it was recently agreed in the I.E.C. to publish a completely revised classification as a separate I.E.C. Recommendation.

This week B.S. 2757 : 1956 has been published and it is, for all practical purposes, identical with the draft I.E.C. document prepared at Philadelphia in 1954, which represents the consensus of international opinion on the subject. The new standard is reviewed in this issue by Mr. R. Snadow who explains that it is intended to be used in the preparation and revision of individual standards for electrical apparatus and consulted as a guide by manufacturers and others who are concerned with the selection of insulating materials.

Three new classes of insulation are introduced including Class H, which previously has been familiar to us in American standards and has already been applied in this country. However, it is not to be expected that all types of apparatus will become available in each of the new classes as in some cases a new class may be standardised in place of an existing one.

SAFER ELECTRIC BLANKETS

The wide diversity of electrical appliances which is now available for use in the home can make a big contribution towards a better standard of living. Unfortunately, however, these appliances, particularly those used for heating, can be a real source of danger if not properly used. It is encouraging, therefore, to see that an effort is being made to increase the safety of electrically-heated blankets by issuing a revised edition of the year-old B.S. 2612. The most important features of the revision are concerned with the strengthening of safety precautions. For example, a new flammability test has been incorporated to ensure that the materials used in blankets will not ignite; highly inflammable materials such as kapok must not be used.

A further modification is designed to minimise the possibility of electric blankets causing radio interference. All blankets made to B.S. 2612: 1956 must carry the British Standards Institution's " Kite-mark " of approval which assures buyers that the product has been independently tested and approved as satisfactory and full instructions and precautions on correct use must be supplied with each blanket.

COMPUTERS IN INDUSTRY

Almost a year ago Bristol Aircraft, Ltd., formed a mathematical services group to work with a " Deuce " electronic digital computer and complementary equipment thereby applying automation to the mathematics of aircraft and guided missile design. This group aims to provide a great deal more than a mere computing service since it is staffed by mathematical consultants who work in conjunction with aeronautical engineers engaged on a specific problem and help them to formulate it in mathematical terms. Once formulated, the problem is solved electronically. There are nine senior mathematicians backed by fifteen girls who have a natural flair for mathematics and have been trained in applying the subject to design office needs. The girls operate desk machines used for preliminary calculation and also assist in the working of the computer.

In this way programmes of calculation can be undertaken which are so involved and abstruse that they could not hitherto have been attempted. Supersonic flight, the heat barrier, the general increase in operating speeds and heights, and the growing complexity of modern aircraft have combined in recent years to make the task of the designer more difficult than ever. As a result, the designer relies increasingly upon the mathematician who, in turn, has increasing recourse to the electronic computer.

EARTH FAULT PROTECTION

In his article dealing with earth fault protection published in this issue Mr. H. W. Swann draws attention to the term " earth fault " and distinguishes it from the expression " earth leakage " which is employed in all editions of the I.E.E. Wiring Regulations. Despite this Mr. Swann suggests, and quite rightly too, that auto-protection is associated with fault current rather than the kind of " leakage " described in Supply Regulation 26 as " one ten-thousandth part."

This regulation does not say that the installation shall not be connected. Furthermore, in Regulation 32 it is laid down that if it is found later on that there is a leakage of more than this specified amount the installation may be disconnected. Thus it would seem that the I.E.E. does not associate the conception of leakage with automatic protection as this might otherwise have been considered the best method of dealing with a bad installation.

As Mr. Swann indicates in his article the point is one of degree and the protection required by the I.E.E. is against dangerous earth leakage for which " earth fault " is at least a descriptive and more distinctive term.

AUSTRALIAN IMPORT LICENSING

In this issue brief broad particulars are given of the further restrictions upon imports which the Australian Government put into force on 1st July. So far exact details have not been made available but sufficient information has been received to make it clear that the effect upon exporters to Australia will be very adverse. As Great Britain is the largest supplier of goods to Australia British manufacturers will be the principal sufferers.

The effect will inevitably be permanent, for while the principal reason for the restrictions is fiscal the encouragement of local manufacture is implicit in them and they mark a further step towards the self-sufficiency which Australia aims at, in common with others of our customers. Once again the need for seeking compensation in freer, less developed, markets is impressed upon British exporters.

Earth Fault Protection

Including Some Notes on Loop Testing

By H. W. SWANN, O.B.E., D.F.H., M.I.E.E.*

THE first note I would like to make under this heading is to invite attention to the term "earth fault" and to distinguish it from "earth leakage." The latter expression is that used in the 13th, and every other, edition of the I.E.E. Regulations and although it is thus hallowed by high authority and supported by custom and usage I suggest that auto-protection is associated with fault current rather than with the kind of "leakage" described in Supply Regulation 26 as "one ten-thousandth part." This regulation does not say that the leakage must be prevented by automatic protection but that the installation shall not be connected, and again in Regulation 32 it is laid down that if it is found later on that there is a leakage of more than this specified amount the installation may be disconnected.

Thus the conception of leakage is evidently not associated in the official mind with automatic protection as otherwise the latter might have been considered a better method of dealing with a bad installation than sending a man round to knock at the door and cut it off—if the consumer lets him in.

The point is of course one of degree and the protection required by the I.E.E. code is against dangerous earth leakage for which "earth fault" is at least a descriptive and more distinctive term.

My next note is on what is a perhaps a rather more essential point—that of finding whether earth fault protection is actually required before taking the trouble to provide it. I am anxious that the idea of fault protection should always be associated in the electrical mind with loop testing and thus I am gratified to find recognition of the latter in Regulation 507 of the I.E.E. 13th edition together with a diagram which I reproduce as Fig. 1 because it shows so clearly the essentials without the frills.

Very few things in this world are quite perfect and it is unfortunate that no loop test can be made on consumers' premises until there is a loop—that is until the service line is available. Thus a contractor wishing to find how he stands about fault protection for a new installation is limited to the advice given in note 2 of Regulation 406 which suggests asking the Area Board about it. Some of the Boards have now purchased a number of loop testing instruments and are no doubt in a position to help the contractor to decide in advance of a test whether earth fault protection is necessary in addition to fuses.

Apart from this, however, the contractor will have to wait for the service before he can use his nice new loop tester. If he then finds that although the contribution of his earth-continuity conductor to the total earth-fault-loop impedance does not exceed one ohm (note to Regulation 407 (B) (v)), the total loop impedance is such that earth fault protection is necessary, he may wish to ask the Area Board about this also. The 13th edition, ample though its guidance may be, does not pursue this point, being limited to the electrical equipment of buildings, a coverage which does not include supply systems or the earthing of their

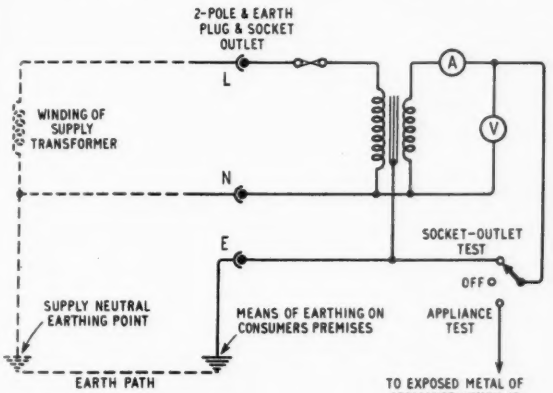
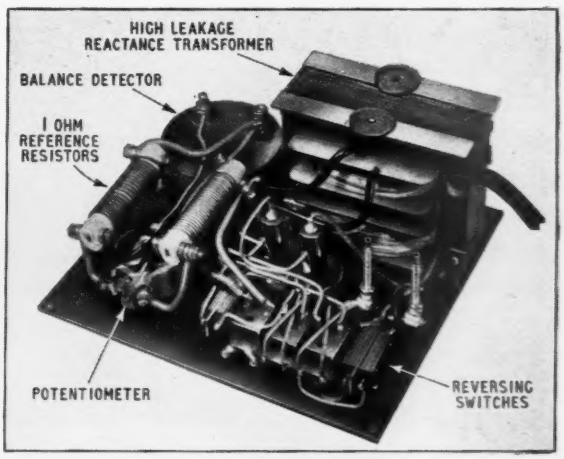


Fig. 1 (above).—Method of loop testing using simple test equipment. (Reproduced by courtesy of the Institution of Electrical Engineers)

Fig. 2.—Injection type earth loop resistance tester, and (right) back view of apparatus



* Mr. Swann was formerly H.M. Senior Electrical Inspector of Factories.

neutral points. It is implicit in Section 4, e.g. Regulation 406 and note 3 thereto, that the contractor must accept the conditions as disclosed by test and provide suitable automatic protection to meet them. The obligations of the Area Board are laid down by the statutory code, under which the neutral point of the supply system must be "connected with earth" in such manner as will ensure at all times an immediate and safe discharge of energy, and there are legal remedies for non-observance of this requirement.

I have said elsewhere[1] that in rural areas the Boards often find difficulty, both economic and practical, in securing and maintaining low values of earth resistance for their transformer neutral to earth connections. Values of the order of 12 to 85 ohms have been measured in the course of an investigation in one area but as the upper figures are rather above the scale ranges of the loop testing instruments at present on the market, some of which stop at 5 or 7 ohms, the users may not be so disturbed as would otherwise be the case.

What Current Value?

There has been some discussion both inside and outside the Institution portals on the value of current desirable for an injection loop test. The note which follows Regulation 507 suggests that it should approach 1½ times the rating of a sub-circuit but need not exceed 25 A. Taking a 10 A sub-circuit as fairly common this means an instrument capable of furnishing test current of between say 10 and 25 A, a value which is not achieved by all the test sets now on the market some of which have a range limit of 8 or 10 A. Such an instrument is shown in Fig. 2. I consider this latter value will in general be sufficient and even if I did not I would rather accept it than put up with the extra weight entailed by incorporating a transformer rated up to 25 A secondary current. If, as I hope, we are to aim at every installation inspector being equipped with both insulation and loop test sets the question of weight becomes a material factor.

The I.E.E. note, however, does no more than express a preference and thus test sets of the hand driven generator pattern (see Fig. 3) which inject up to about 60 mA are not excluded by any regulation. Opinion varies as to the relative accuracy achieved at such low values of current but these sets furnish "reversed d.c." and thus measure resistance, not impedance, and are fitted with synchronous rectifiers to prevent stray current interference. These are useful features on occasion but where the loop resistance includes an oxide film, say at the surface contact of an earthing clamp, the power output, some 5 or 6 W, may not be enough to break it down although these instruments work up to 100 V.

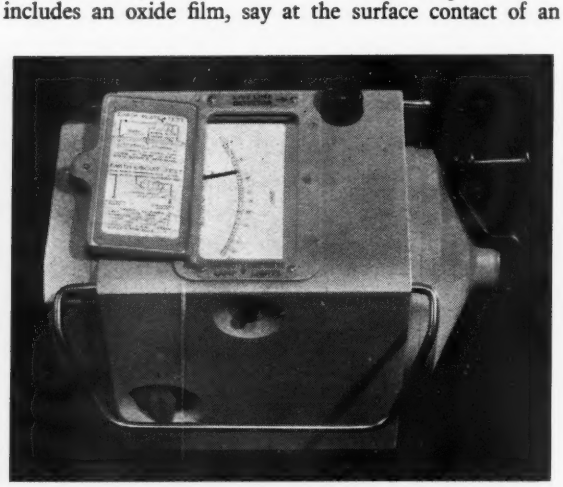


Fig. 3.—Hand driven generator for loop testing and earth plate testing

Taking the matter of high resistance loops and test current values a little further, if there is, say, 40 ohms at the supply transformer or elsewhere and the test injection voltage is limited to 40 (as prescribed) the testing current will be only 1 A or less and the value is not dependent on whether the design of the instrument provides for 25 A or not. It is perhaps at this order of loop resistance that the test is most useful in disclosing really dangerous conditions and I do not think they are altogether uncommon although I should like to be corrected on the point. At such values inaccuracy in measurement due to voltage drop in the neutral is unlikely to be important although it appears to be a material factor in tests within the one ohm range where also the question of impedance of steel conduit, as against ohmic resistance, arises. These latter points have in fact been raised recently in the correspondence columns of this journal[2] where Mr. W. E. Sage has said:—

> "While an earth loop impedance as low as about 1 ohm is not required until circuits of 60 A and above are considered (Reg. 406 gives 1.33 ohms max for a 60 A 240 V circuit), where a whole loop of such an impedance or less is tested, in the manner suggested in Reg. 507, but at only 10 A, the voltage developed across it may become comparable with the neutral voltage drop. In a test continued throughout a day on an unloaded 15 A socket outlet, earthed through conduit, having a d.c. earth loop resistance of 0.55 ohms and an a.c. impedance of about 1 ohm, a current of 10 A produced voltages across the loop varying between 6 and 12 V, the neutral voltage drop varying meanwhile between zero and 3.5 V."

The point Mr. Sage raises about neutral voltage drop leads to the question of the phase difference between the injected current and that in the neutral at the moment of test. It is this consideration I imagine which has led some manufacturers of test sets to incorporate a reversing switch, but however this may be, the latter does appear to be a desirable feature. The phase of the neutral voltage drop must be constantly changing with load balance variation and some tests I have made myself with a tester fitted with a reversing switch showed values, on the same loop, of 1.6 - 0.8 (average 1.2 ohms) 1.4 - 0.86 (average 1.3) and 1.5 - 0.8 (average 1.15). Tests of this order with a number of different makes of instrument working side by side would perhaps be instructive but even allowing for the variations which I expect would be observed, I am not sure that at the one ohm ranges of measurement they are really vital to the general principle or object of loop testing. I hardly expect instrument makers to agree with me however, either on this, or when I say that whilst a lead plate accumulator battery is not a thing which one willingly carries very far yet where transport is available a 12 V car type battery can be used for loop testing in conjunction with, for instance, an "Avo" set or a separate voltmeter and ammeter.

A contractor friend of mine has reduced the test equipment to a pair of leads, of which he knows the resistance, from his car to the cupboard under the stairs and uses the ammeter on the car instrument panel to measure the current injected. He has not troubled about a voltmeter but just works out $\frac{12}{I}$ and then $\frac{240}{R}$ to find whether the main and power circuit fuses stand any chance of going on an earth fault. (He lets the lighting circuit fuses take a chance.)

Thus I think we have to face the point as to just how accurate a loop test need be. Most people have done without it for a good many years and although I think they were

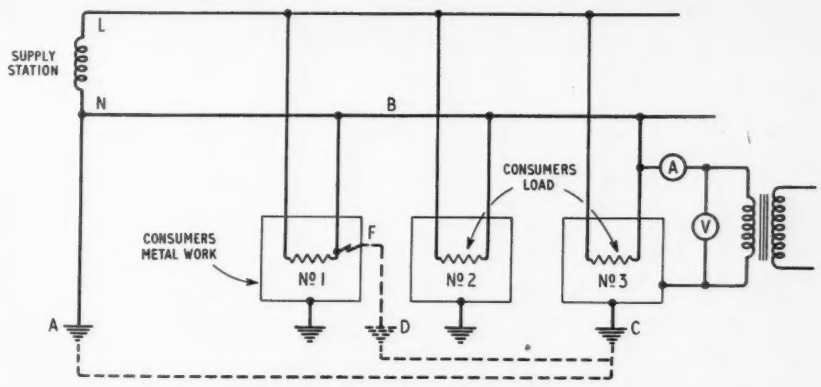


Fig. 4.—Diagram showing the effect of dormant faults on a neutral conductor on the accuracy of a loop tester

or are, misguided, it would hardly seem that we need plunge from doing nothing to a state of great anxiety if our loop tests do not achieve a high degree of accuracy, especially as the impedance values measured may change overnight if it rains. Thus the purpose of the test may very well be to get a reasonably reliable idea of the approximate loop impedance so that the marginal allowance for contingencies can be made wide enough to leave no doubt that if an earth fault occurs the automatic protection—either fuse or earth fault circuit-breaker—will operate in time to prevent danger.

Another point with a bearing on accuracy arises when there are dormant faults to earth in the insulation of the neutral conductor. I am told that such faults are more common than is generally supposed and I know of one district where loop testing has been abandoned because there are so many neutral faults that it is considered worthless. The point is brought out in Fig. 4 where consumer number one has a fault on the neutral at F. A loop test on the premises of consumer number three will measure not only the impedance of loop CAB but also that of loop CDFB in parallel and thus give a misleading result because if consumer number one clears his fault, say by opening a d.p. main switch when going off for a holiday, it may so increase the loop resistance as to result in the fault protection at number three becoming inoperative. Another nice point of course is that if number two or three, or others in the neighbourhood, develop earth faults some of the current may return to neutral via number one and be enough to set the place on fire. It is perhaps surprising that so little is said about dormant faults on the neutral in any code of regulations.

Where consumers' metal work is solidly bonded to the neutral conductor at the supply terminals, as in p.m.e., no loop testing is possible at consumers' premises.

Responsibility for Testing

I think my next note may properly be about the relative responsibilities of Area Board, consumer, and the contractor acting for the latter, in connection with testing. It is a comparatively rare event for an electrical case to get as far as the Courts but when it does the conclusions reached are likely to be worth study. One such case in 1954 was especially concerned with relative responsibilities for a fatal accident at an electric wash boiler, earthed by a contractor to a spike of which the resistance to earth was afterwards found to be 75 ohms. There was about 8 ohms at the neutral of the supply transformer and thus the fault current was limited by loop resistance to some 3 A, a value nowhere near the operating current of the 12 A circuit fuse.

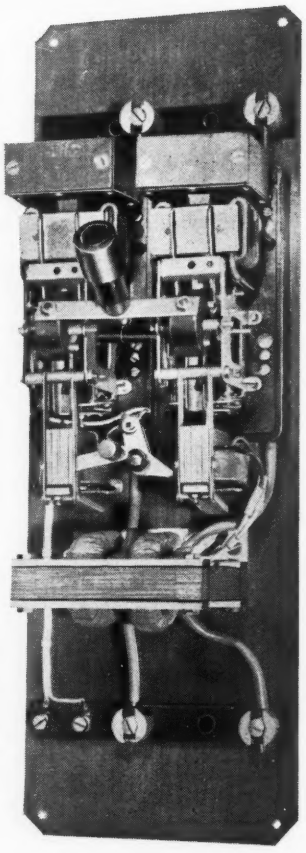
In a considered judgment of some length[3] it was held that the contractor had a contractual obligation and a duty in common law, neither of which he had fulfilled, a failure which cost him a total of £530. The Area Board successfully resisted a claim based in part on an alleged breach of Supply Regulation 27, it being held that although they took no steps to satisfy themselves about the resistance, being content with a merely cursory inspection, they committed no offence as there was no obligation under the regulation to carry out any inspection or testing at all. I do not feel sure that this decision would be upheld in a higher court, but accepting it, as we must, then testing by a Board is evidently just a part of the service they give to their consumers.

Most consumers of electrical energy earth their metal work to the underground metal pipe system of their water supply authority, a privilege for which they pay nothing, but if the latter decides to transmit the water in non-conducting pipes then the electrical consumer must turn elsewhere. Where the Electricity Board supplies him by way of an underground metal sheathed service cable it will as a rule permit the consumer to use it for earthing, thereby almost certainly saving the cost of separate or additional earth fault protection. A form of indemnity is required in most cases under which the consumer recognises that he has no claim against the Board should this means of earthing prove unsound. When the consumer is served by an overhead line and finds difficulty in securing a sufficiently low value of loop impedance the Boards, in some districts, may provide an aerial earth wire for the consumer's use, which again will save the latter the cost of earth fault protection additional to overload fuses. I do not think a form of indemnity is required, so that presumably an ungrateful consumer could go for the Board if the overhead earth wire broke or was otherwise ineffective. In some rural areas the Boards, recognising their consumers' earthing difficulties, may obtain approval of a scheme of p.m.e. carried out free of expense to the consumer and again saving him the cost of fault protection. Furthermore, in some parts of the country Boards have incurred appreciable expense in endeavouring to improve, that is to reduce, the resistance of the connection with earth at the neutral points of the supply transformers, and it should be remembered also that continual maintenance is required to retain the values of resistance achieved. These measures, with the testing of installations which I mentioned earlier in this note, are all primarily for the safety of the consumer and the latter pays for them, as part of the electrical service he enjoys, by way of his electricity meter.

One might expect, as a matter consistent with this general policy of service, that the Boards would consider the inclusion of automatic earth fault protection, which would tolerate relatively high values of loop impedance, as an alternative to the efforts enumerated above, but so far as I know this course is adopted by only one Board and then only as the last hope on the list. No indemnity is sought in this case to relieve the Board of responsibility if the protective device sticks and indeed, if I remember rightly, regular service is provided, although I imagine the places of use are not numerous.

It is perhaps on this matter of service that the inclusion of automatic fault protection really turns. The first cost

would often compare with that of aerial earth wires, or p.m.e., but if failure of an automatic mechanism occurs it is directly obvious, and more likely to lead to compensation troubles, than, say, ineffective earthing to cable sheath, or p.m.e. With this point in mind it is relevant to look at the Boards' statutory obligations as laid down in Regulation 24 of the Electricity Supply Regulations, 1937.



I never feel quite sure which way round this regulation should be read, because the opening words—"For protection against excess energy"—do not indicate who is to be protected. Although the marginal note says it is the consumer this note is not a part of the regulation and if the latter is read in the light of the original powers conferred by the Act of 1882 it might well mean that the Board is to be protected against, say, a short circuit on the consumer's installation which might upset the general supply to other consumers.

Accepting, however, the guidance of the marginal note, this protection becomes a further measure for inclusion in the list of services to the consumer for which he does not directly pay. Read in this way the Boards are required to insert auto-protection against danger from excess energy in every service line. I believe the term "excess energy" would be held to mean energy in excess of the normal working rate, or healthy load, and thus that the regulation implies protection against danger resulting from short circuit, sustained overload, or earth fault on the consumer's installation. It would be very difficult to attempt discrimination between these functions in a court of law, or to expect support for an argument that earth fault protection was not included, because the whole intention of the various services such as earthing to cable sheath, and p.m.e., are directed towards making automatic earth fault protection effective.

Although the Assize Court ruling cited above appeared to relieve the Boards of an obligation for testing a consumer's installation, at least under Regulation 27, I think it is implicit in other regulations expressing a requirement with which compliance can only be established by measurement and test. Thus the protection of the consumer under Regulation 24 goes further than just fixing some fuse boxes near the meter and implies a test to find if they are likely to work. Apart from statutory duty it might be thought somewhat inconsistent to apply the results of a loop test to the consumer's auto-protection but not to that installed by the Board. If a test shows the Board's protection to be ineffective in any one of the three essential functions I believe that the terms of the regulation are not fulfilled

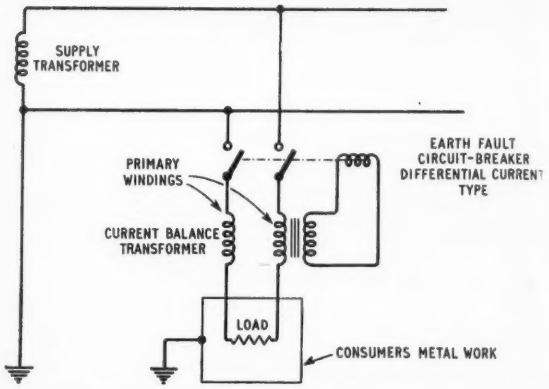


Fig. 5 (left).—Differential current earth fault circuit-breaker and (above) connection diagram

and, in the case of the earth fault feature, that they are faced with a choice between reducing loop resistance and adopting auto-fault protection—a point on which I hardly expect full and undivided support.

Turning now to maintenance, the Supply Regulations appear to cover both earth electrodes and earth fault circuit-breakers in that respect. The Boards are enjoined to maintain an effective connection with earth of the neutral points of the supply system "at all times" (see definition) which I take to mean all the time, or for ever and ever. If they find this a too expensive method of ensuring an "immediate and safe discharge of energy," and put in an earth fault circuit-breaker to do it, then the latter constitutes "apparatus" for which they would be responsible under Regulation 25 (a) for both initial installation and subsequent maintenance. The same regulation also says that apparatus must be suitable for its purpose, a requirement which suggests an earth fault circuit-breaker—a measure incidentally which would be of assistance also in meeting the terms of Regulation 16 (a) which specifies all due precautions so as to avoid risk of causing fire when delivering energy to the premises of a consumer.

These statutory obligations are, I suggest, all relevant to the economics of consumer protection and affect all questions of selection of method with the subsequent maintenance associated with each.

It is perhaps permissible to say at this point that the supply regulations seem to expect that earth fault current, or aggregate leakage current, is inevitable and will return to the neutral point through the connection with earth at the source of the system of supply because under Regulation 4 (v) the Boards are permitted to make a test at that point to ascertain whether the current passing is normal. The regulation does not, however, say what is "normal," in terms of load, or number of consumers and thus "normality" probably varies widely as between different localities. Where the supply is d.c. a lead is given in Regulation 2 which restricts the leakage current from the system to one-thousandth part of the maximum supply. This regulation by the way seems to be confined entirely to the Boards, who are required to maintain their supply system insulation in sound condition "so that the leakage current" does not exceed the value given above. It seems to me that aggregate leakage from consumers' installations, especially in d.c. areas where they are likely to be of some age, cannot leave the Boards with much margin, but as it would be difficult to separate consumer leakage from that arising from the Boards' own lines and apparatus for purposes of measurement, anxiety as to the true position is unlikely to make anyone unhappy.

It would be interesting to know what order of current

value is "normal" in system connections with earth, especially where there happen to be a few good sized electrode boilers about. Water, gas and telephone authorities would all greatly value such information.

There is a wide difference between the form and effect of those clauses of the Supply Regulations which are concerned with protection and earthing on medium voltage supply systems and the closely specified requirements of Regulation 7 which relates to high voltage lines—a term which in my view incidentally includes busbars and associated switchgear by reason of definitions and context. If an earth fault occurs on such a system the current resulting must be not less than twice the operating current of a protective fuse, or other suitable overload preventive device. Alternatively protection may be provided by way of a "suitable discriminative fault current relay," which implies some form of differential protection. If the Supply Regulations are revised at some future date I suggest with deference that Regulation 7 might be studied and its scope extended to medium voltage systems—a course which would make it possible to drop several other regulations with benefit to the clarity of the Code.

There is a disparity of a rather similar character between the protective measures prescribed for high voltage electrode boilers and those for medium pressure. Supply Regulation 8 (v) (b), which is concerned with the former, asks for a "suitable" circuit-breaker set to operate at 10 per cent unbalance (or 15 per cent if the lower value is awkward). Unbalanced current flowing to boiler shell is much the same as earth fault current for which a differential current circuit-breaker would be "suitable" and this is the device required by I.E.E. Regulation 321 which also deals with high voltage boilers. If however the boiler is supplied at low or medium voltage Supply Regulation 4 (VII) (a) requires only bonding between boiler shell and cable sheath (it makes no mention of supply by way of overhead line) and says nothing about differential protection. A differential current earth fault circuit-breaker is illustrated in Fig. 5. The I.E.E. Regulations go somewhat further and appear to allow, under Regulations 322 and 323, connection of the shell to the neutral conductor—a course which, although wise, does not seem to take account of Supply Regulation 4 (VIII) which says it is not permissible for the Boards to do it without approval. If there is some dispensation for the consumer, such as that for p.m.e., the two identical notes which appear under I.E.E. Regulations 322 and 323 might have been coalesced into one which says something about it.

Here again then if automatic differential current protection is a suitable safeguard for a high voltage boiler one might expect some reference to the application of that method to medium pressure cases if only in a sense alternative to the clauses devoted to showing how you can do without it.

The pattern of Supply Regulation 7 appears also in the newly issued statutory Cinematograph (Safety) Regulations 1955 which came into force on 1st January. Under Regulation 20 (3) (a) and (b) earth leakage protective devices are required unless the possible earth fault leakage current substantially exceeds that required to operate plain overload protection. This is also in line with the sense of I.E.E. Regulation 410 except that the latter refers to earth-leakage currents whilst the writer of the official text sought to have it both ways by using the expression "earth fault leakage."

Protective Devices

Much has been said and written in recent years on different forms of automatic earth fault protective devices, the desirability of monitored earth continuity[1] conductors, and the relative reliability of circuit-breakers which may stick in, compared with earth electrodes which may dry up. The use of a monitored earth continuity conductor can be seen in Fig. 6. I think it is a mistake to imagine that salvation lies in any one hard and fast protective method and I suggest that comparisons should always be based on facts. A simple form of voltage operated earth fault circuit-breaker like that shown in Fig. 7 may be entirely suitable for the protection of occupiers of small houses from shock risk, whilst the more expensive differential current type may be a valuable and selective safeguard when applied to group feeders, as for instance those from the main switchroom to the various buildings constituting a school, hospital, or factory. The operational settings desirable are specified in the I.E.E. Regulations as not exceeding 40 for voltage operation and for the differential type not more than 15 per cent of the rated current for the circuit, or 5 A, whichever is the greater.

I have often heard it said that this latter operational setting is too high to afford the protection against fire which is the primary function of the differential circuit-breaker. The point is important because electrical fire

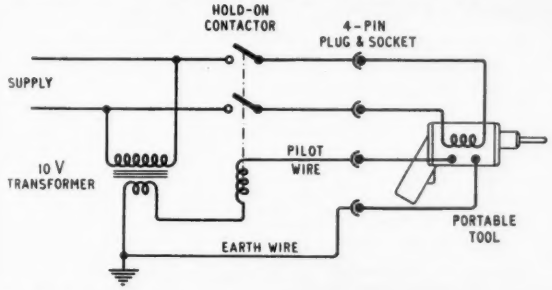


Fig. 6 (above).—Connections for a portable tool showing monitored earth continuity conductor

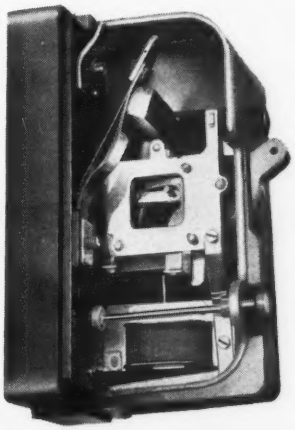
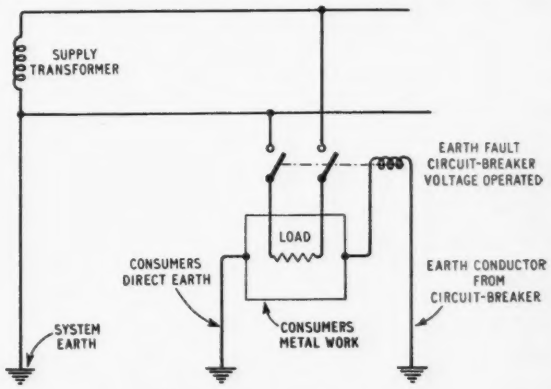


Fig. 7.—Voltage operated earth leakage circuit-breaker and circuit diagram showing the chance earthing of consumer's metalwork



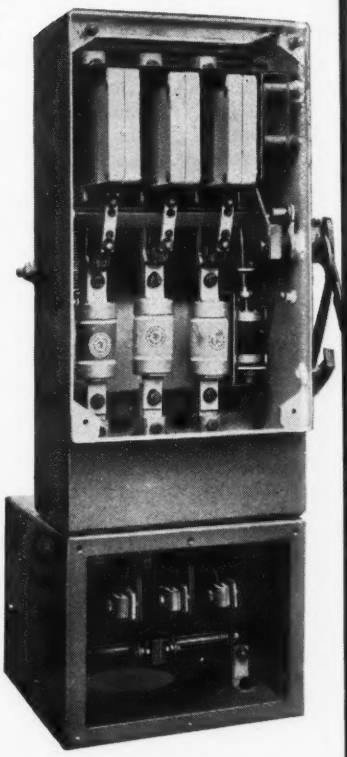
risk, which now stands at about 18 per cent of the fires from all causes (8,000 in 44,000), is steadily increasing, but the question of setting must be kept in proper perspective. For instance a circuit rated at 100 A is better protected by a circuit-breaker which will open on an earth fault of 15 A than by a 100 A fuse which goes at 160 to 180 A. Again, as the application of the differential type is mainly to whole installations, or group feeders, it is desirable to give the fuse protected sub-circuits, say 5 to 10 A rating, a chance of clearing an earth fault before the main breaker comes out. There is also something to be said for keeping in line with official codes, as for instance Regulation 17 of the Quarries General Regulations (Electricity) 1938 which specifies the same setting as the I.E.E. and Regulation 8 (V) (b) of the Supply Regulations referred to earlier in these notes.

Against these points it can be said that settings of this order may fail to prevent danger, and thus to provide the absolute protection implicit in statutory regulations. This is quite true but given the right conditions a fire can be started at very low energy values of a few watts concentrated over a small area, which is much below the practical possibilities of ordinary circuit breaker construction. For instance a sensitivity of ½ amp at 240 V is equivalent to 120 W which is far too high for absolute safety but provides a high degree of relative safety.

Cases where operational settings of 15 per cent would have prevented serious fires have occurred within my own experience and other instances are given by Mr. F. H. Mann[5] who writes of a case in which one department of an extensive factory was largely destroyed by fire resulting from an uncleared earth fault on a sub-circuit branched from a main circuit protected by 200 A fuses. A failure of insulation within conduit melted the latter over a length of about 2ft 6in.

I have laboured this matter of operational setting perhaps unduly but I know there is much uncertainty about it. The position can, I think, be summarised by saying that there is no need to plunge from plain overload fuse protection allowing fault current of say 150 A to the opposite extreme of say 150 mA. Fifteen amps is a very reasonable and practicable compromise which will prevent a lot of fires.

Having said this however I must add that where electricity is used under inflammable conditions, as for instance in some coal mines, or factories making or using inflammable solvents, quite low values of earth fault current may be incendive and give rise to the most serious troubles. Mr. P. N. Wyke[6], writing in this journal, has said in connection with coal mining power equipment that it is not generally possible for a core balance (i.e. differential) transformer to operate at much below 5 A except at great expense and he describes a new system (outlined in Fig. 8) in which the three phases are starred through an impedance of approximately 20,000 ohms and coupled to earth through a relay incorporating a thyratron valve. This relay is arranged to operate at about 8 milliamps, a figure which it is thought may considerably reduce the incendive risk but allows unwanted operation on occasion due to its high sensitivity. When used in conjunction with a fault search circuit the latter trouble can be much reduced in its effect.



B.T.H. switch fuse coupled to a three-phase differential transformer which operates an explosive "striker" fuse on the occurrence of a fault and trips the mechanism

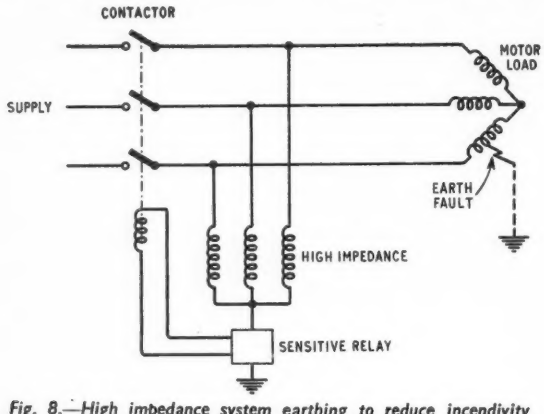


Fig. 8.—High impedance system earthing to reduce incendivity of earth fault energy

The same point is taken in connection with inflammable factory processes in "Electrical Accidents" for 1953[7] where the suggestion is made of earthing through a high impedance relay to limit the flow of fault current to earth, the intention being to reduce it, if possible, below the incendive energy value.

There are also obvious difficulties in applying auto-earth fault protection to low current reactive circuits such as choke coils for radio interference suppression, or for discharge lighting control or for radio sets and in so far as earth faults in such equipment may be expected to cause a rise of temperature the safeguard appears to be that of thermal relays of which suitable types have been developed and made available.

Grateful acknowledgements are made to the following for advice and permission to use illustrations or diagrams:—Institution of Electrical Engineers, B.T.H. Co., Ltd., Chilton Electric Products, Ltd., Dr. G. F. Tagg, B.Sc. (Evershed & Vignoles, Ltd.), and Mr. R. E. Jennings, A.M.I.E.E. (Foster Transformers, Ltd.).

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Log-Log Scales and Interest Rates

Method of Filling the Gap below 1·1

By O. M. MEARES, B.A., M.I.E.E.

ELECTRICAL engineers often have occasion to make calculations of the type $y = (1 + r)^n$ in connection with the accumulation of money at compound interest or the growth of electrical load on a system at the rate of 100 r per cent per annum. Quite a lot of trouble can be saved by knowing how to make the best use of whatever resources may be available for calculations of this type. To keep the following description as clear and brief as possible it will be confined to considering a single example, viz. the calculation of the growth of a load in nine years at 8 per cent per annum starting from unity, or $y = 1{\cdot}08^9$.

The easiest way of solving this equation is to look up the answer in compound interest tables showing the value of £1 after n years. Such tables are to be found in many reference books. They are set out very fully in *Inwood's Tables of Interest*, or in shorter form in the abbreviated edition of these tables, "abridged for the use of engineers," published by the Technical Press, Ltd. Reference to the tables gives the result as 1·99900.

This method cannot be used for fractional rates of interest or growth not listed in the tables, and in such cases there is no escape from the need to do a little work. At this point the engineer is entitled to expect some help from that prop of his declining arithmetical powers, the slide rule; but the chances are that even if his rule is provided with a log-log scale it will be of the "short" type, extending from 50,000 down to 1·10 and stopping dead just at the point where it might begin to be useful. The range from 1·01 to 1·10, covering all likely interest rates and rates of growth, is entirely omitted, and the owner may have felt with some justification that if he cannot use his log-log scale for calculations in this range except after resort to some clumsy juggling with the figures, then it is not worth bothering with it at all.

There is, however, a way of dodging this difficulty which does not seem to have been published, but which is neat, easy to remember and capable of filling the whole of the gap below 1·1 on the "short" log-log scale to full slide rule accuracy. It rests on the fact that when r is small, $\log_e (1 + r)$ is very nearly equal to $r/(1 + r/2)$.

The description that follows applies to the common type of rule with two layers of log-log scale, covering the ranges 1·1 — 2·9 and 2·6 — 50,000 on the stock above and below the "A" and "D" scales respectively. As a first approximation, $\log_e (1 + r) = r$, which in our example is 0·08; so that 8 on the "D" scale is not far from the correct position to represent 1·08 in the missing third layer of log-log scale. To obtain the exact position all that is necessary is to push the slide about $\frac{3}{16}$in to the left, into the position for calculating $1/(1 + r/2)$, i.e. 1/1·04, and then to use 8 on the "C" scale as representing 1·08. This position corresponds to 770 on the "D" scale, and reference to tables will confirm that $\log_e 1{\cdot}08 = 0{\cdot}0770$.

Using the cursor to mark this position, set 10 on the "C" scale below the cursor line, and the powers of 1·08 can then be read off on the log-log scale opposite the corresponding numbers on the "C" scale. In particular, $1{\cdot}08^9$ can be read off, opposite 9, as 1·999. As compared with the use of an "extended" log-log scale this involves only a moment's mental arithmetic and one movement of the slide, and it is far quicker to do than to describe.

The fact that this method is correct to the full accuracy of the slide rule over the whole of the missing range up to 1·1 can be confirmed by noting that $\log_e 1{\cdot}1 = 0{\cdot}09531$ and $1/1{\cdot}05 = 0{\cdot}09524$, differing by less than one part in a thousand. An alternative check, and one that serves as a simple reminder of the method, is to set the slide for 1/1·05, when unity at the left-hand end of the "C" scale will be seen to come directly opposite 1·10 on the log-log scale. The method lends itself without difficulty to inverse calculations such as (in our example) $1{\cdot}999^{1/9} = 1{\cdot}08$, and in short, enables the slide rule to deal very quickly with any simple problem in involution or evolution likely to arise in practice, without losing the advantage of the inherently high accuracy possessed by the log-log scale in the lower part of its range. For example, the distance from 1·04 to 1·05 on the log-log scale is more than 20 times as large as the corresponding interval on the "C" and "D" scales.

Another dodge for these sums is worth mention, since it is so useful as a rough check. It is that the number of years required for a quantity to double itself at compound interest is approximately equal to $70/r$. The fact that $1{\cdot}08^9$ is nearly equal to 2 is a particular example.

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Keadby Power Station

360 MW TRENT-SIDE PLANT FULLY COMMISSIONED

THE Keadby power station, which is now operating with its maximum installed capacity of 360 MW, had its first 60 MW turbo-alternator/boiler unit commissioned in April, 1952. Since that time, five more units of the same capacity have been brought into service, and the final unit was commissioned in December last year.

The station is situated on a 181 acre site on the eastern bank of the River Trent about half a mile to the west of the village of Keadby in Lincolnshire. The site is divided in two by a public road, the 48 acre eastern section containing the main buildings together with the office block, workshops, stores, canteen and medical section, while the western section contains rail reception sidings, the wagon tipplers, the coal storage area and land for ash disposal.

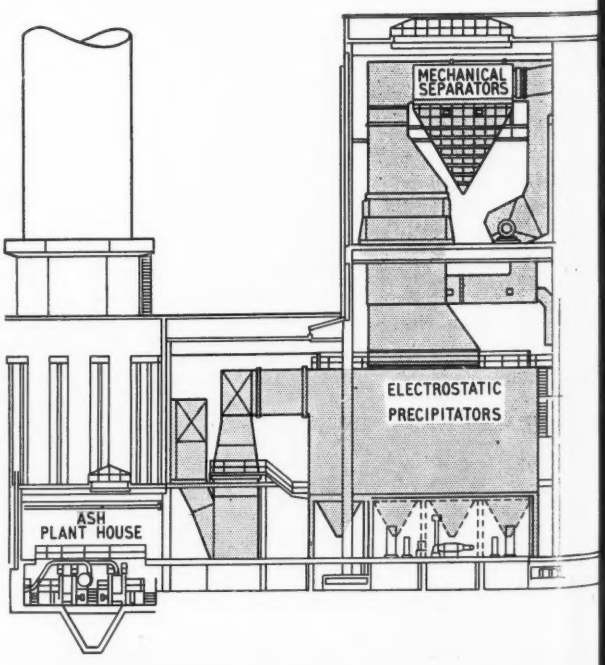
The main boiler and turbine house building is a steel framed brick clad structure about 470ft long by 410ft wide. There are three 325ft high brick chimneys and each serves two boilers.

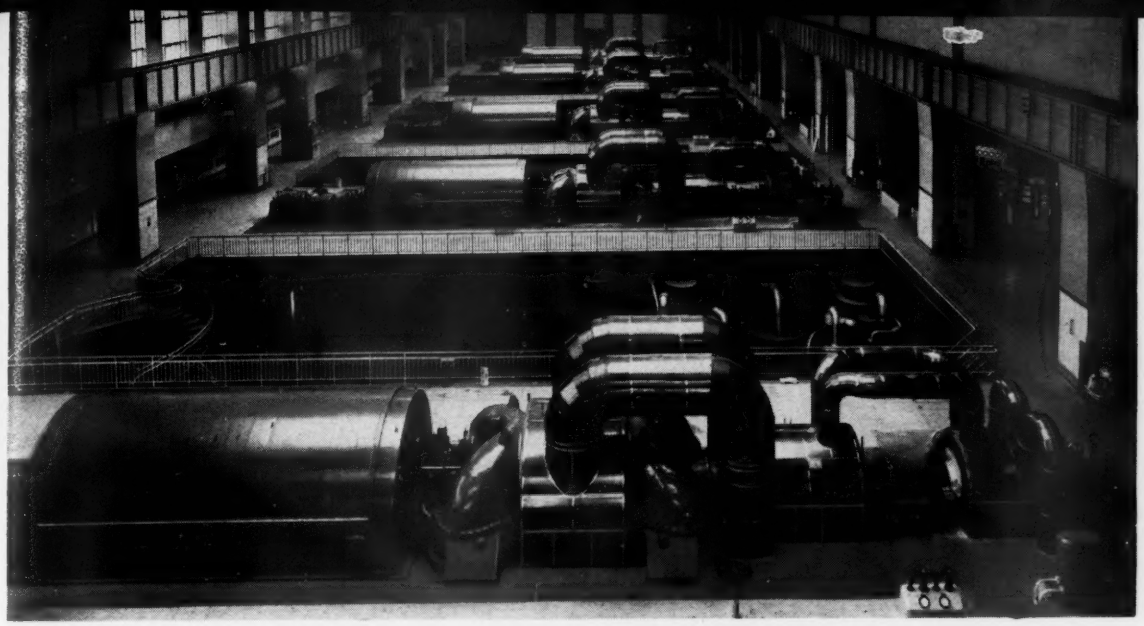
Each of the six turbo-alternator/boiler units consists of a 550,000 lb/hr boiler and a 60 MW hydrogen-cooled turbo-alternator set. The generating units are arranged side by side down the length of the turbine room which is of rather striking appearance. The walls are tiled up to a height of 8ft and above this they have been specially treated to reduce noise. This treatment consists of wooden studding attached to the walls on to which is then fixed a layer of hardboard. The hardboard is in turn covered by a layer of glass wool followed by a layer of linen which is finally covered by peach coloured perforated anodised aluminium sheeting. A sound absorbent construction using acoustic tiling has been followed also for the roof of the turbine house and adjoining bays. In accordance with unit station practice there is no dividing wall between the turbine and boiler houses.

Coal is delivered to the station by both rail and road. For rail-borne coal there are two tracks leading from the main lines on to the site, one for incoming trains and the other for outgoing. The tracks run to the wagon sidings, which are split into two sections for full and empty wagons and which together can hold a total of 650 wagons. From the full sidings the wagons are handled by shunting locomotives to four wagon tipplers, each of which is designed to handle 12 wagons/hr of any size up to 32 tons gross weight to give a total coal handling rate for the four tipplers of 500 tons/hr.

There is a twin belt conveyor system to the six 1,000 ton capacity boiler bunkers and these are designed to deliver coal at the rate of 500 tons/hr. The conveyor system incorporates screening plant by means of which coal, bigger than can be handled in the pulverising mills, is passed to crushers and then returned to the main conveyor system. Road-borne coal is discharged on to the coal store where it is mixed as required with other coals before it is used. Any temporary shortage of supplies arriving at the station is made up from the coal store where three 95 h.p. bulldozers are used for general coal storage purposes. The annual coal consumption for the completed station is about 1,000,000 tons with, in the winter, a weekly consumption of about 25,000 tons.

The ash and dust resulting from combustion in the boilers is collected from three places associated with each boiler unit: from the ash hoppers at the bottoms of the boiler furnaces, from the hoppers of the centrifugal separators and from the hoppers of the electrostatic precipitators. In addition, there is an extraction point



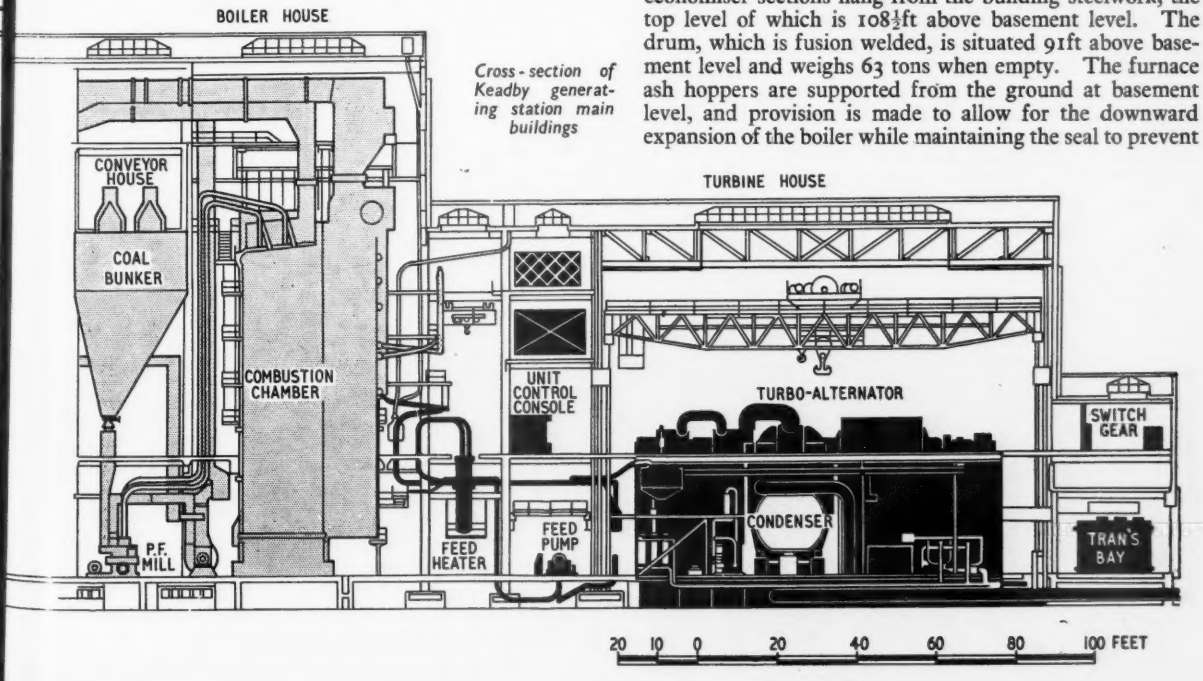


General view of the turbine room showing one of the unit control panels to the right under the crane rails

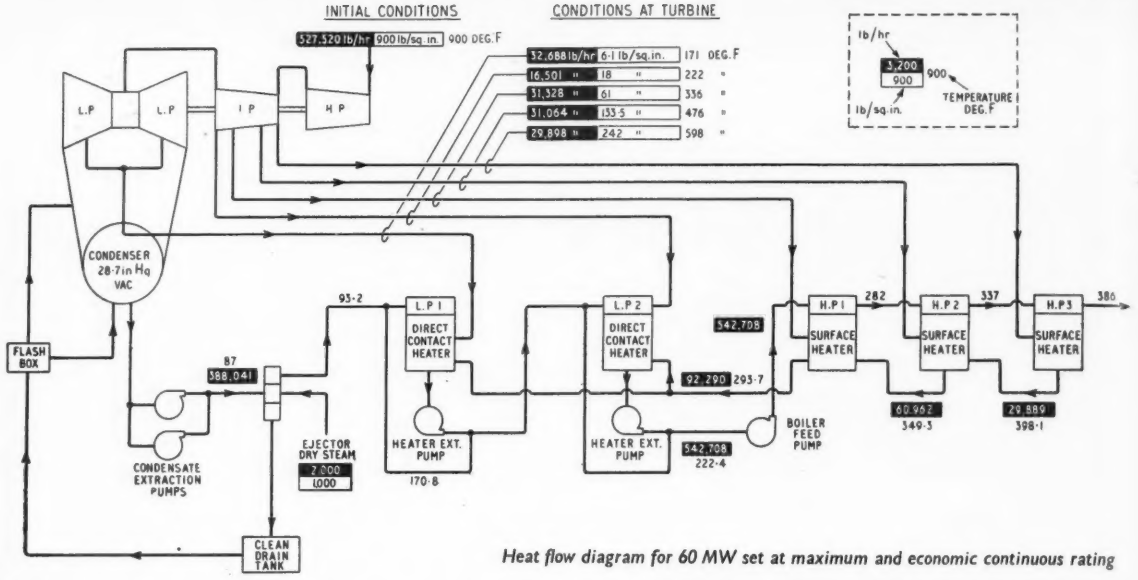
from the hopper at the base of each chimney. Ash is collected in the hoppers beneath the furnace of each boiler and is removed into a sluiceway by means of high-pressure oscillating water jets. At intervals along the sluiceway are water jets which direct the ash to one of the duplicate clinker grinders through which it passes before entering the ash sump which is situated between Nos. 1 and 2 chimneys. A valve in the sluiceway allows the water and ash mixture to be admitted to the selected clinker grinder. Dust is extracted from the precipitator hoppers by water ejector units and from the chimney bases by hydrovactors and discharged into sluiceways taking it to the ash sump. From here the ash and water mixture is pumped by means of two ash pumps in series through a cast iron pipe 1⅛in thick and about 2,300 yd long to the ash ponds. Here, due to reduction in velocity of the water, the ash and dust settle out and the clarified water is returned for re-use via a 24in concrete pipe to a storage pond outside the boiler house.

The Babcock & Wilcox " Hydro-Jet " system is used to deliver the ash to the sump and for this there are two 100 per cent duty horizontal centrifugal sluice water pumps rated at 1,700 gal/min at 150 lb/sq in and each is driven by a 270 h.p. 1,475 r.p.m. squirrel cage induction motor. For pumping the ash from the sump to the settling ponds there are two sets of two horizontal centrifugal ash pumps rated at 1,700 gal/min at 70 lb/sq in, each being driven by a 190 h.p. 735 r.p.m. squirrel cage induction motor.

The completed station accommodates six boilers which were ordered from the Stirling Boiler Co., Ltd., now incorporated with Babcock & Wilcox, Ltd. They are of the single-drum radiant type, fired with pulverised fuel and have a maximum continuous rating of 550,000 lb/hr, the pressure and temperature of the steam at the superheater outlet being 925 lb/sq in and 915 deg F. These boilers are of the suspended type in which the drum and the whole of the furnace and the superheater and economiser sections hang from the building steelwork, the top level of which is 108½ft above basement level. The drum, which is fusion welded, is situated 91ft above basement level and weighs 63 tons when empty. The furnace ash hoppers are supported from the ground at basement level, and provision is made to allow for the downward expansion of the boiler while maintaining the seal to prevent



Cross-section of Keadby generating station main buildings

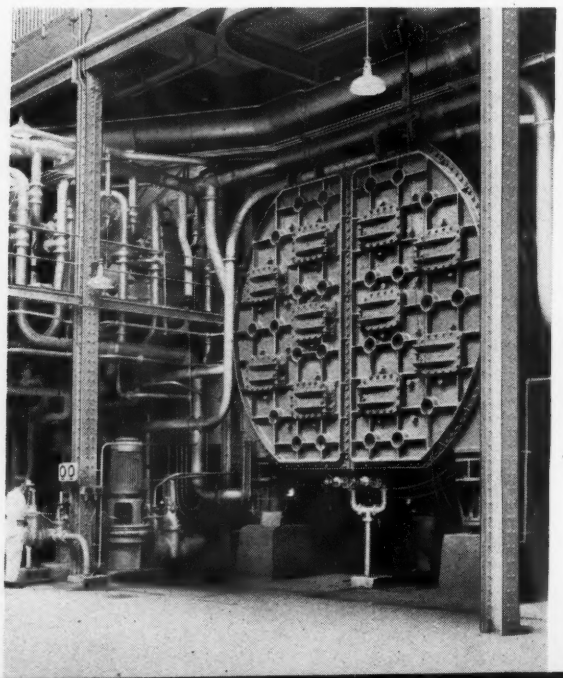


Heat flow diagram for 60 MW set at maximum and economic continuous rating

ingress of air into the boiler between the boiler casing and the ash hoppers.

The boiler furnace is completely water cooled, with closely pitched 3in o.d. tubes, and it is, in effect, two furnaces placed side by side with a central vertical wall of tubes between them. Each half furnace has its own ash hopper at the bottom. In the roof of the complete furnace is a total of eight pulverised fuel burners of the vertical multi-tip inter-tube type. The flame path is thus vertically downwards and the hot gases leave the furnace near its bottom and turn vertically upwards to pass first through the superheater tube banks and then the economiser tube banks, finally leaving the boiler at the top of the boiler house; the superheaters are of the multi-loop counter-flow self-draining type. The primary and secondary banks are each arranged in two sections. Between the primary and secondary superheater sections a spray type attemperator is connected to provide means of regulating the steam outlet temperature. The economiser is arranged in three sections, one of which is situated in the gas ducting at the boiler gas outlet, except on No. 6 boiler, where all three banks are in the economiser pass.

Each turbine exhausts into a single-shell two-pass condenser



For each boiler there are four Babcock & Wilcox type E56 9 tons/hr capacity pulverising mills, although any three mills can provide the necessary quantity of fuel to a boiler to enable it to run at full load. Each mill is driven by a 110 b.h.p. 1,460 r.p.m. L.D.C. motor. Coal from the bunkers passes to each mill hopper through an automatic Simon weigher and is fed into the mill by a two-speed rotary table type feeder constructed integrally with the mill. For each mill there is a primary air fan, the suction for which is taken from the main air ducts before and after the air heater and each is rated at 18,000 cu ft/min at 26in w.g. The two suction tappings facilitate temperature control at the mill outlet. Each is driven by a 140 h.p. 1,465 r.p.m. squirrel cage induction motor. Each mill also has a Keith Blackman sealing air fan with a capacity of 200 cu ft/min at 40in w.g. and 80 deg F air temperature.

The air heater equipment for each boiler comprises two regenerative type Howden-Ljungstrom units having a total heating surface of 142,200 sq ft. Each is designed to raise the temperature of the air delivered by the f.d. fans from 90 deg F to about 550 deg F. Provision is made for by-passing the air side of the heaters to maintain the temperature above that of the dewpoint of the gases when raising pressure or running on light loads.

The air supply for each boiler is drawn from the top of the boiler house through two f.d. fans and passed through the air heaters to the twin furnaces of the boiler. The products of combustion are drawn from the boiler by the two i.d. fans. The gases first pass through ducts which run over the top of the boiler into mechanical dust collectors, then through air heaters and finally through the Sturtevant electrostatic precipitators to the fans which discharge into the chimneys. The i.d. and f.d. fans were both supplied by James Howden & Co., Ltd., the former being driven by 685 h.p., 735 r.p.m., 3·3 kV motors and the latter by 264 h.p., 735 r.p.m., 3·3 kV machines.

Boiler Control System

The boilers are equipped with a Bailey system of control which operates on the series-parallel system to control the flow of fuel and air to each furnace so that the steam pressure and temperature remain constant. It also ensures that the ratio of total air to fuel remains at a value suitable

to the boiler load and that optimum combustion conditions are maintained. The system is actuated by a master pressure controller which is equipped with a standard setting enabling the desired operating steam pressure to be selected manually. Any deviation of actual pressure from the standard setting gives rise to an air signal which immediately creates variation in the fuel firing rate and the combustion air supply rate to ensure instantaneous adjustment. The relationship between steam and air flow eventually provides an impulse embodying the master signal to ensure the optimum combustion conditions. The three-element system of steam temperature control incorporates the measurement of final steam temperature as the first element, the measurement of combustion air flow as the second, and the measurement of the rate of flow of cooling water to the attemperator as the third. The temperature of the coal-air mixture is regulated by adjustment of the hot air and tempering air supply dampers, while a temperature controller regulates the variation in the position of these dampers, and the feeder controllers regulate the coal supply to the pulverising mills. Each control can be selected for either manual or automatic operation. Compressed air for operating the control equipment of the six boilers is supplied by three 120 cu/ft min 100 lb/sq in compressors supplied by Reavell & Co., Ltd., and each is driven by a 35 h.p. 960 r.p.m. L.D.G. squirrel cage motor.

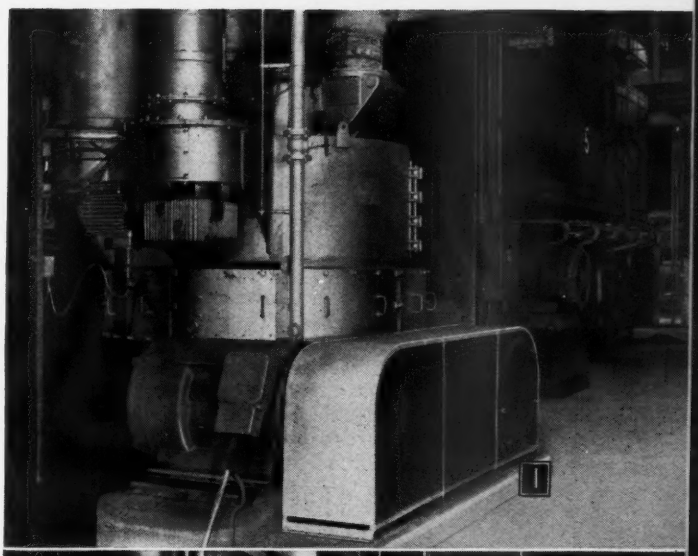
Turbo-Alternator Arrangement

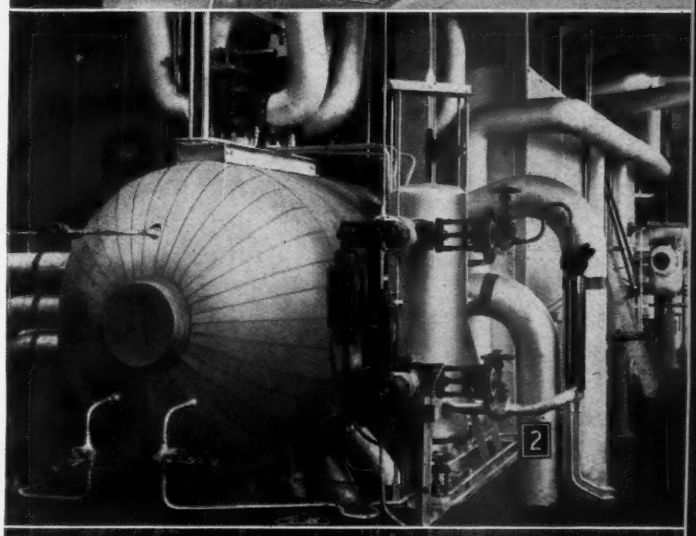
Each of the six turbo-alternator sets is rated at 60 MW, 0·8 power factor, 11 or 11·8 kV at 3,000 r.p.m., with steam at the turbine stop valve at 900 lb/sq in and 900 deg F. Each unit is supported on a reinforced concrete foundation block at 30ft above basement level. The turbine is a three-cylinder reaction type machine, with a double-flow low-pressure cylinder exhausting its steam into a single-shell two-pass condenser. There are nineteen stages in both the h.p. and i.p. cylinders while the double-flow l.p. cylinder has six stages in each flow.

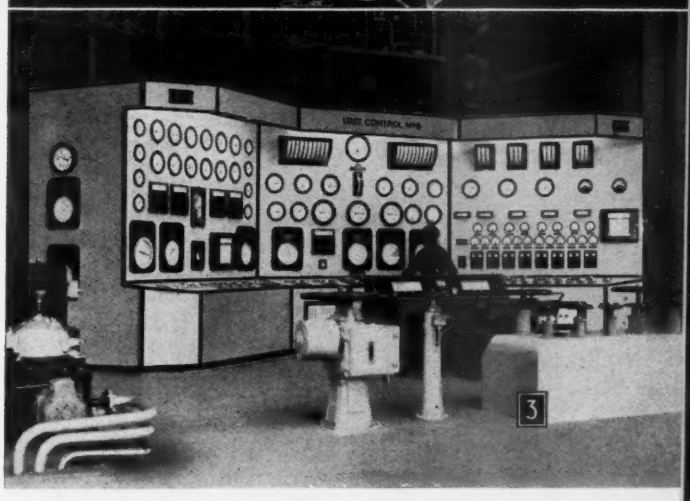
The steam exhausts from the two halves of the l.p. cylinder into a single condenser of the divided water box type, having a total cooling surface of 60,000 sq ft and a capacity at m.c.r. of 387,890 lb/hr.

There are three Parsons two-stage air ejectors and one quick start air ejector for each turbine. The two-stage ejectors are arranged two for 60 per cent and one for 40 per cent duty and each is designed to operate at a steam pressure of 400 lb/sq in with a steam consumption of 2,000 lb/hr under starting conditions. The quick start ejector is supplied with saturated steam at 1,000 lb/sq in at a rate of 6,500 lb/hr and discharges directly into the atmospheric pipe. Condensate is drawn from each condenser by two 100 per cent duty vertical extraction pumps each with an output of 710 gal/min against a total head of 105ft. Each pump is driven by a 45 h.p. 975 r.p.m. L.D.C. induction motor.

The feed heating train consists of two l.p. stages and three h.p. stages. The h.p. heaters, which were supplied by C. A. Parsons & Co., Ltd., are of the surface type and each has a steam capacity of about 30,000 lb/hr. The l.p. feed heating train comprises two direct contact de-aerating heaters in series and a 100,000 lb/hr shunt de-aerator all made by Hick, Hargreaves & Co., Ltd. The two heaters are designed to raise the temperature of the condensate from 93 deg F up to about 220 deg F at full load, the latter temperature corresponding to the saturation temperature of the second l.p. tapping point. At full load final feed water temperature of the boiler is 385 deg F. The boiler make-up is supplied by three "P. & B." triple-effect evaporator distillers made by Aiton & Co., and each







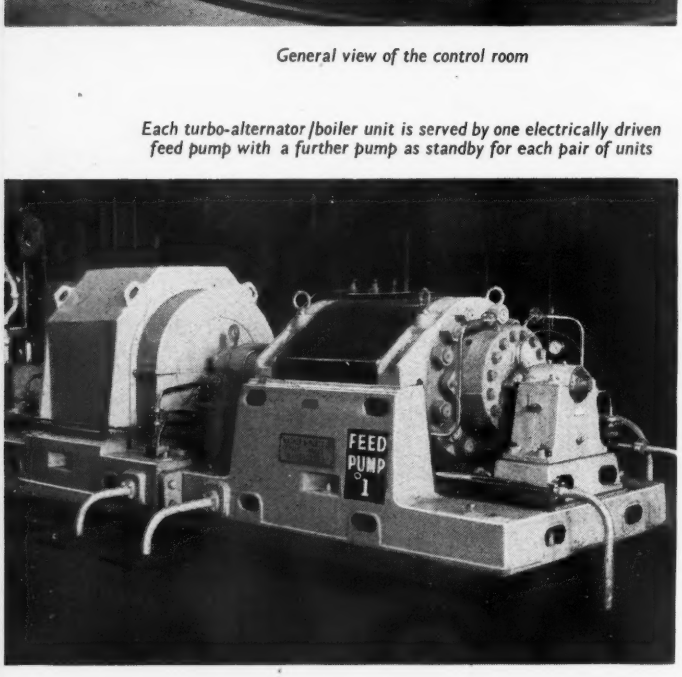
1. Each boiler is served by four B. & W. Type E56 pulverising mills. 2. No. 6 boiler from drum level. 3. No. 6 unit control board

is capable of producing 30,000 lb/hr of silica-free water of very high purity.

For the purpose of delivering feed water to the boiler each turbo-alternator/boiler unit is provided with one electrically driven feed pump with one stand-by feed pump between each pair of boilers. Each pump is designed to discharge 650,000 lb/hr of water against a pressure of 1,225 lb/sq in at 3,000 r.p.m., and is driven by a 3·3 kV 1,435 h.p. water-cooled motor. Both pumps and motors were supplied by Mather & Platt, Ltd. The cooling water for circulating through the condensers is taken from the River Trent, and there are six intakes for this water along the west bank of the river. All intakes go beneath the road alongside the river to the circulating water pump house, where each intake feeds one of six circulating water screens, water from which is fed to six circulating water pumps. These pumps deliver the water through three 72in diameter bitumen lined steel pipes to the station and similar pipes discharge to the river at a point about 2,000ft downstream of the intake. The circulating water pumps are vertical units driven through extended shafting at 365 r.p.m. by 740 h.p. 3·3 kV motors supplied by Laurence, Scott & Electromotors, Ltd., and each is capable of handling 2·7 million gal/hr of water against a head of 45ft. The river at this point is tidal, with a range of up to 19ft, and the levels have been fixed to ensure that the motors are above high tide level and the pumps always below the river flow.

General view of the control room

Each turbo-alternator/boiler unit is served by one electrically driven feed pump with a further pump as standby for each pair of units



Make-up Treatment

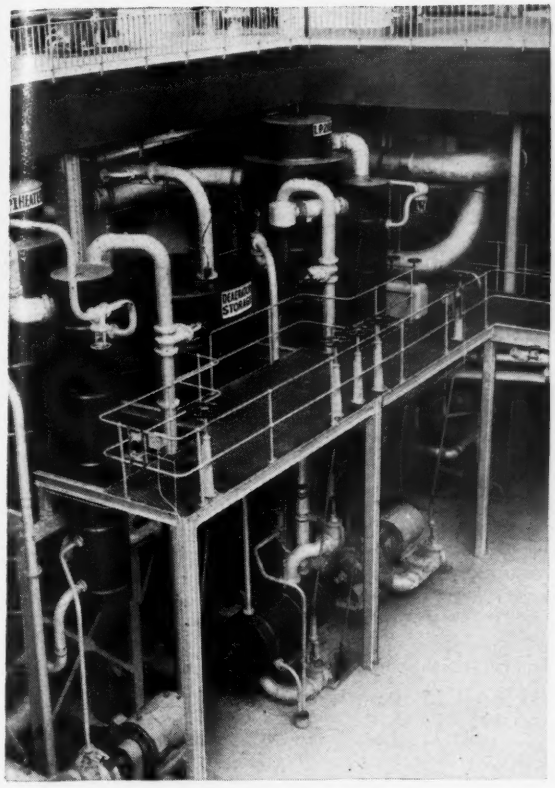
Boiler make-up water is also taken from the River Trent. Initially, it is heavily charged with suspended silt and mud so it has to be clarified. First, the water is fed into two pre-sedimentation tanks where the heavier particles are separated out. It is then passed, with suitable coagulation materials added, to an Aitken type sedimentation tank, where most of the remaining suspended solids are deposited. The water is finally passed through sand and anthracite filters and then pumped to four 25,000 gallon filtered water storage tanks in the station. From the storage tanks the water passes to a blended base exchange water softening plant and then pumped to softened water storage tanks. It is fed as required to the three live steam triple-effect evaporators referred to above, and finally finds its way into the feed system of each turbo-alternator/boiler unit.

Because the river is saline for long periods, with a salt content which may reach 30 per cent, there are times when it is necessary to shut down the water softening plant which cannot operate efficiently with this quality of water. As the demand for make-up water for the boilers is a continual one, a large stored quantity of softened water is required to tide the station over these periods. In addition to four 25,000 gallon storage tanks situated inside the station, a further 250,000 gallon tank has been provided for this purpose and it is placed outside the boiler house on the south side of the building.

Each turbo-alternator/boiler unit in the station has associated with it a control console on which are mounted all the indicators and controls required for the operation of the unit. All indicators are mounted on the vertical section of the console, while the controls are situated on the lower sloping portion. Each console is arranged in three sections, the left-hand one accommodating equipment associated with the turbo-alternator and the middle and right-hand sections, equipment for the boiler.

Each of the six 60 MW 3,000 r.p.m. alternators is of conventional Parsons design and arranged for hydrogen cooling, the main and pilot exciters being gear driven from the main alternator shaft to run at 1,000 r.p.m. Each generator is solidly connected to a generator transformer which steps the generator voltage of 11 kV up to 132 kV. The transformers for sets 1, 2 and 3 are rated at 75 MVA and for sets 4, 5 and 6 at 72 MVA, the latter being the new standard rating for this size of turbo-alternator. They are of the forced oil water-cooled type, with two coolers per transformer, one of which is intended to be a standby to the other. These transformers are all fitted with on-load tap-changing gear and are situated in outdoor cells along the north wall of the main building.

A little farther to the north of the main buildings is the 132 kV open-air substation to which the output from the generator transformers is taken. Control of the feeds from the generator transformers and to the various outgoing transmission lines is by means of Reyrolle air-blast circuit-breakers with a breaking capacity rating of 2,500 MVA. The substation accommodates circuit-breakers for six generator feeders, two station transformer feeders for general supplies to the power station itself, and eight out-



L.p. feed heaters and de-aerator storage vessel

going feeders, in addition to circuit-breakers for bus section, bus coupling and for two reactors.

Electrical supplies for the station are obtained from two sources: from the two 7.5 MVA station transformers, which are fed from the 132 kV substation, and from the 6 MVA unit transformers, one of which is connected directly to each of the alternators. Basically, the turbo-alternators and boilers are operated on the unit principle, i.e., supplies for essential auxiliaries are taken from the associated unit transformers. The supply voltage for these auxiliaries is 3.3 kV. Electrical supplies for starting the sets and the boilers and for station auxiliaries generally are obtained from the station transformers at 3.3 kV. Smaller auxiliaries are fed at 415 V. Supplies for the essential unit auxiliaries are obtained from duplicate unit auxiliary transformers which are supplied by each turbo-alternator/boiler unit. These transformers are fed at 3.3 kV from the associated unit transformer switchboard.

Supplies for coal handling, ash handling, circulating water pump house and for general station auxiliaries are obtained at 415 V from duplicate transformers fed from the station transformer 3.3 kV system. All transformers, including generator and station transformers, are placed at ground level in an annexe running along the north side of the turbine house. All 3.3 kV switchgear for the station boards and the six unit boards is of the air-break type with a rated breaking capacity of 150 MVA and is situated in the same annexe as the transformers, but at turbine house operating floor level. Control panels for this switchgear are set into the dividing wall between the turbine house and the annexe in which the switchgear is situated, the various controls being operated from the turbine room. The 415 V gear is generally of the switch fuse and contactor type or of the switch fuse only type.

The cables between the generator transformer and station transformer 132 kV terminals and their associated 132 kV circuit-breakers are of the oil-filled type. The 3.3 kV and most of the 415 V cabling is aluminium sheathed.

The control room, a circular building between the turbine house and the 132 kV substation, houses the control and relay panels for the 132 kV switchgear and for some of the 3.3 kV switchgear. The panels are arranged in a circle, the relay panels being back-to-back with the control panels, but separated by a passageway.

With its total installed capacity of 360 MW Keadby is at present making an important contribution to the country's electricity supply. In the year 1955, when only five of the six sets were in operation, a total of 2,000 million kWh was supplied to the grid system at a thermal efficiency of 28.66 per cent.

The design and construction of the Keadby station has been carried out under the direct supervision of the Chief Engineer's department at the headquarters of the Central Electricity Authority, in conjunction with Messrs. Ewbank & Partners, Sir William Halcrow & Partners, and Farmer & Dark. The last-named were also responsible for architectural treatment. The main contractors for the station were:—Civil engineering works, Sir Robert MacAlpine & Co., Ltd.; boilers and ash-handling plant, Babcock & Wilcox, Ltd.; turbo-alternators and transformers, C. A. Parsons & Co., Ltd.; coal-handling plant, Spencer (Melksham), Ltd.; and switchgear, A. Reyrolle & Co., Ltd. Acknowledgement is due to Mr. G. A. Vowles, controller of the Yorkshire Division, C.E.A., for permission to publish this article and to Mr. W. J. Prior, superintendent of the station, for invaluable assistance in the preparation of the material.

NUCLEAR STATION TECHNICAL STAFFS

ARRANGEMENTS have now been made for thirteen engineers to receive training with the Industrial Group of the United Kingdom Atomic Energy Authority and manufacturers' groups. Those to be appointed to the first nuclear power stations have been considered under the headings of "Management," "Charge Engineers," "General Assistant Engineers" and "Specialist Grades." Under the heading of "Management" would be experienced power station engineers and who would become station superintendents and chief maintenance engineers of the first stations. Charge engineers are engineers with operational experience in the industry. They would follow the Harwell Reactor Course, and would then receive practical training under the Atomic Energy Authority at one of the operational stations for about four months. A number of general assistant engineers would be given operational training at the A.E.A. stations. Some of them might also take the Harwell Reactor Course.

Special grades are designated (a) instrument engineers; (b) safety and health physics; and (c) foremen operatives. Three instrument engineers experienced in power station instrument work would receive six months' training with the A.E.A. late in 1958. Two or three men would be sent to the A.E.A. for training in safety and health physics. Subsequent training would be determined in the light of experience gained when the atomic energy stations were in operation. Foreman operatives would probably need one year's training at a nuclear station before taking up their duties.

It has been stated by the C.E.A. that the training of the management personnel would have to begin first with attendance at the Reactor School in September this year. It was also reported that the first member of the Nuclear Power Branch had been appointed following advertisements inside and outside the industry, to which there had been a good response.

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The Royal Show

E.D.A.'s LARGE-SCALE ELECTRICAL EXHIBIT

THIS year's annual show of the Royal Agricultural Society of England was held at the Town Moor, Newcastle, where record crowds attended on Tuesday of last week, the opening day. Probably no exhibit in the Show attracted more attention than "Electricity Farm" arranged jointly by the British Electrical Development Association and the North Eastern Electricity Board. It was the largest ever sponsored by E.D.A. at a Royal Show, occupying a site of 22,000 sq ft, compared with 15,000 sq ft at Nottingham last year.

The exhibit was complete with all the farm buildings for a holding of about 150 to 200 acres and was stocked with pedigree cows, two litters of pigs and about two dozen head of poultry. As a whole it demonstrated the many applications which can be carried out more efficiently and economically with the aid of electricity and many of the items of equipment in each section were seen under actual working conditions.

Dairy Equipment

The dairy section was in two main parts. One consisted of a two-point milking parlour, with recorder-releaser; milk cooling, bottling and cold storage plant with appropriate steam raising and water heating equipment; and an electric milk delivery vehicle. The other part included hot water, steam raising and milk cooling equipment for the requirements of varying sized herds and different methods of milking and also ancillary equipment for the stock farmer. An automatic pressure controlled piston pump was installed in conjunction with this section and a display of other types of electrically operated pumps demonstrated their particular applications under rural conditions.

In a Danish type pig house electrical aids in the farrowing, rearing and feeding of pigs were demonstrated by the use of electrical equipment for floor warming, infra-red heating, food preparation and controlled ventilation. The poultry was shown in a section of a deep litter house, in conjunction with a display of automatic lighting and ventilation equipment. Various appliances for the incubation, hatching and rearing of chicks, egg washing, poultry plucking and deep freezing of poultry products were also displayed. Animal food preparation plant in the form of automatic millers, food mixers, oat crushing and root cutting appliances were shown in a "working" barn layout. In the farm workshop demonstrations of electrically operated tools and arc welding apparatus were given.

In the farmhouse itself, a timber bungalow (the building used at the Torquay Power Convention) there was a fully electrically equipped kitchen and living-room and the remainder of the house was used as a showroom for many modern domestic electrical appliances, including those for water heating, cooking, refrigeration and laundering purposes. There was also a greenhouse in which were demonstrated space heating and soil warming applications, including an enclosed propagating bench. Equipment for lawn mowing, hedging, hoeing and soil sterilising was also on view.

The display of the General Electric Co., Ltd., indicated in a striking manner the progress that has taken place in designing and developing electrical appliances for use on the farm, in horticulture and in the farmhouse. In the crop drying section of this stand was a model of a multi-purpose crop dryer, together with a display showing alternative constructions of drying areas. Platform and silo grain dryers of varying capacities and a range of infra-red heaters for animals were also displayed. Equipment for the horticulturalist included two forms of glasshouse heater, one having a galvanised water trough which, when filled, enables the humidity of the glasshouse to be raised; the other, a weatherproof tubular heater, is available in lengths from 4 to 12ft.

It is generally accepted that if seed potatoes are chitted before planting, growth of the crop is more even and the yield is increased. When storing potatoes in trays in chitting houses lighting is required to control the growth of the shoots which usually develop above 40 deg F. In addition to fittings which the G.E.C. had introduced earlier, the company displayed for the first time a new 8ft portable fluorescent fitting designed for chitting houses. The control gear is housed in a sheet steel box fixed to the bottom of the fitting, which has a hook suitable for overhead suspension and a simple plug adaptor.

Among domestic appliances comprising vacuum cleaners, kettles, fires, lighting fittings, etc., was the latest G.E.C. 8 cu ft refrigerator, a de-luxe model which has a door with facilities for storing butter, eggs and milk.

Visitors concerned with agricultural plant and machinery incorporating electrical equipment such as motors, starters and control gear found much of interest on the British Thomson-Houston Co.'s stand. Many of the working exhibits seen here were supplied by a 6.25 kVA "Stavolt" engine driven alternator developed by the B.T.H. primarily for providing a.c. power to isolated communities and agricultural areas still awaiting connection to the public electricity supply. The new B.T.H. "Stayrite" a.c. single-phase power drive available in 2, 3 and 5 h.p. sizes, also shown, consists of two com-

ponents, the motor and its associated starting unit. A special feature of the motor is its low starting current, only 1.5 times the normal full-load current. The 2 and 3 h.p. motors develop 75 per cent full-load torque at starting, while the 5 h.p. unit develops 60 per cent. B.T.H. f.h.p. motors were shown driving butter churns, poultry plucking machines, pumps and refrigerating equipment, whilst larger motors, up to 12½ h.p., were shown fitted to grain dryers.

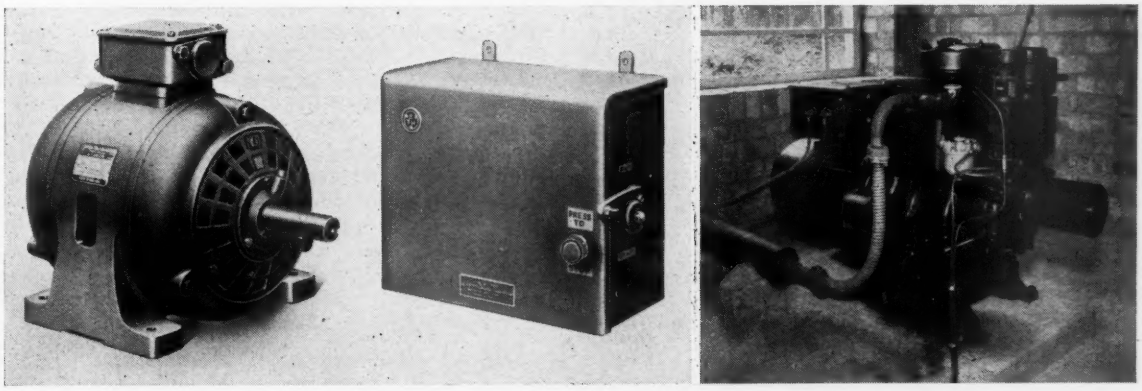
A large number of fixed and mobile generating sets were on view and on the stand of R. A. Lister & Co., Ltd.; a representative selection included the Lister air-cooled diesel "Start-O-Matic" plants. This range has been extended and now includes a 1½ kW model in addition to the existing 2½, 4½ and 7½ kW sizes. This company also displayed their "Premier" animal clipper which made its first appearance at the Dairy Show late last year.

A. Reyrolle & Co., Ltd., exhibiting at a Royal Show for the first time, showed their new class "J" range of outdoor ring-main oil switches and fuse switches of the extensible and non-extensible types. Where busbar cable connections are required a special busbar chamber having the cable-box below it is used, thus giving maximum space economy without restriction of extensibility. Conversion from one arrangement to another can readily be carried out on site should the need arise. The equipment, although suitable for any situation, is primarily intended for controlling electrical supplies to rural areas.

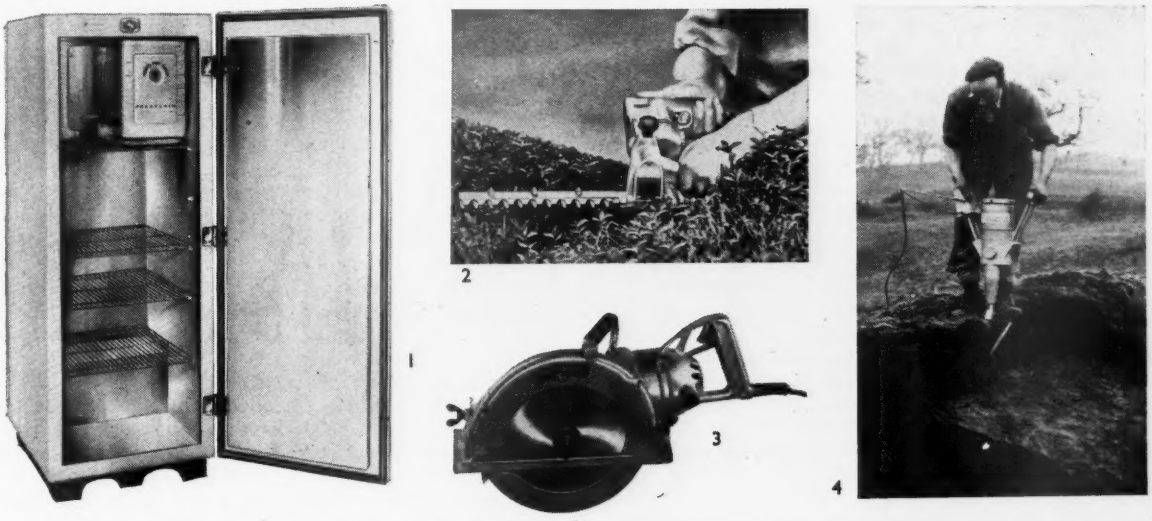
Among a large collection of refrigeration equipment the Pressed Steel Co. had on view their new "Prestcold" SC.131 13.2 cu ft service cabinet. In this model special attention has been given to providing maximum internal storage capacity within small external dimensions, and very little floor space is required. The company also had on view a very wide range of commercial and domestic refrigeration equipment for the farm, bottle coolers, counter display units, etc. Similar displays were to be seen on the stands of Frigidaire, J. & E. Hall, Ltd., and York Shipley, Ltd.

On the C.A.V. stand there was a representative selection of fuel injection equipment for diesel engines and electrical equipment for agricultural tractors and stationary and portable engines. Dynamos for battery charging and lighting were shown, together with control boards and switchboards and special lamps for tractors for road use and night ploughing.

A new development of J. W. Woolley & Co., Ltd., is the "Flexibin" grain drying and storage system. Basic-



Left: B.T.H "Stayrite" motor and associated starting unit Right: Lister 1½ kW "Start-O-Matic" generating plant powered by a 3½ h.p. diesel engine



(1). "Prestcold" SC.131 13.2 cu ft service cabinet (2). Wolf hedge trimmer attachment (3). Tarpen Engineering Co.'s model 121 "Swifsure" portable saw (4) Atkinson's "Silo-Aid" silage cutter

ally it consists of a fan heater unit, two or more quick-drying bins, each with a capacity of three tons, and simple storage bins. The total loading of the electric models is 36 kW and power is provided by an 8 h.p. three-phase motor. Single-phase models are also available.

The repair of farm machinery and equipment is being undertaken more and more by the farmer himself in his own workshop, and the range of portable electric tools now available covers most of his requirements. Black & Decker, Ltd., had a wide selection of sanders, bench grinders, drills, portable saws and electric hammers, among which were a new 7in standard sander, a medium-power machine specially designed to have a wide general application. The "Utility" range of tools with its large number of attachments was also shown. Wolf Electric Tools, Ltd., also exhibited a wide range of portable electric tools, including drills from ¼ to 1¼in capacity, grinders, sanders, screwdrivers, etc. Of special interest was the Wolf farm maintenance kit, and new equipment included a hedge trimmer attachment for either light trimming or hard cutting back on long hedges or small shrubs. Two machines which had not previously been seen at a Royal Show were shown by the Tarpen Engineering Co., Ltd. One of these, a 10in chain saw, weighs only 14½ lb and is suitable for lopping, pruning and log cutting. The other, the "Swifsure" model 121, is a heavy-duty portable motor saw with a 4⅜in cut which can be used for ripping or cross-cutting timber on a production basis. The company also showed their popular hedge trimmers, "Grassmaster" and their combined hoe/tiller which was shown for the first time last year.

Another company which appeared for the first time at a Royal Show was Loblite, Ltd. On this stand could be seen a watertight and all-insulated farm wiring system. Designed to operate under the severe conditions which are found on farms, it consists of non-corrosive plastic conduit and fittings for surface wiring and complete watertightness is achieved by rubber gaskets and screwed cable entry glands. This company also had on view its new range of three-in-one universal well glass fittings suitable for accommodating lamps up to 150 W. The housing is made in a strong non-corrosive moulded material and is very suitable for outhouses, milking sheds, etc.

One of the new implements for agricultural purposes entered for the Society's silver medals was an instantaneous moisture meter seen on the stand of Scottish Mechanical Light Industries, Ltd. It consists of a probe unit and a special ohmmeter with a built-in 500 V generator. The moisture content of grain in bulk and in sealed sacks can be measured without the need for sampling, each moisture determination taking only five seconds. A temperature correction device, attached to the instrument case, allows for instantaneous reading of the true moisture content under any climatic conditions. Another entry was the "Silo-Aid" power-operated tool for cutting silage, peat or farmyard manure. This machine, which was seen on the stand of Atkinson's Agricultural Appliances, Ltd., incorporates an oscillating blade driven by either a petrol engine or a ½ h.p. a.c. electric motor. It is designed to cut a straight face and square corners to a depth of 8in at a rate of 12 ft per minute.

Electric fencing equipment was shown by the Wolseley Engineering Co., Ltd., and R. J. Fullwood & Bland. The latter company makes use of an expendable-type dry battery for its "Fullwood" unit, thus cutting out the need for accumulators and their recharging. Several firms made use of a demonstration van, including Philips Electrical, Ltd., where in addition to their mains model "Philishave" demonstrations were given of their battery version. The range of Kenwood products, including food mixers, irons, etc., was shown in a similar manner, as also were the washing machines, cleaners, polishers and scrubbers, etc., of Hoover, Ltd.

The electrical contractors for the Show were Dale Electric, Ltd., of Yorkshire, who laid altogether about 55 miles of cable of all types for power to drive the machinery exhibits and milking machines in the cattle lines, catering requirements, stand lighting displays, broadcasting, etc. Four substations were erected.

Electricity in Cyprus

THERE is little in the report just received from the Electricity Authority of Cyprus to show the difficulties facing the Authority in carrying out its electrification scheme under the troubled conditions at present existing in the island. Only one incident is recorded, in which a 2,500 kVA transformer in the 66 kV main substation at Karvounas was damaged by unknown persons and had to be removed from service for repair. The report by the secretary, Mr. T. S. C. McIlwain, refers to the rapid increase in sales and, looking to the future, he expresses the belief that the modern electricity supply system now being provided will prove to be one of the most important factors in the social and economic progress of Cyprus.

The Authority, of which Mr. H. F. Carpenter, C.B.E. (formerly secretary of the British Electricity Authority) is chairman, met seven times in 1955, Mr. Carpenter presiding on five occasions. Accompanied by the general manager and chief engineer (Mr. J. O. Hall, O.B.E.) he carried out a comprehensive tour of the Authority's areas of supply during the year.

For the first time since the Authority was set up—1955 was its third full year of operation—there was a net surplus (£76,390) which reduced the deficit carried forward to £63,285. Although the position is regarded as promising, it is pointed out that the undertaking is still in the development stage and large capital expenditure has to be incurred. At 31st December last the aggregate capital outlay was £5,242,943, a sum of £1,049,676 having been spent during the year. Discussion took place with the Government on the financing of the third stage of the electrification scheme, on which expenditure is expected to amount to some £3 million.

Work in progress under the second stage includes an extension of the power station buildings at Dekhelia to accommodate a 14,000 kW turbo-alternator and two 90,000 lb/hr oil-fired boilers. This extension is expected to be completed by the end of the year. A further extension is planned under the third stage. Last year the power station generated 72.7 million kWh, the maximum load being 17,500 kW. Smaller (diesel) stations are in operation at Famagusta, Larnaca, Limassol, Nicosia, Paphos and Plastres.

The length of 66 kV transmission lines in service at the end of last year was 182 miles, an increase of 24 miles. The second stage of the electrification scheme includes the extension of the secondary transmission system by approximately 200 miles of 11 kV overhead lines; some 55 miles had been erected at the end of December and 26 miles were under construction. The 11 kV transmission system in towns and rural areas was extended by

some 34 miles of overhead lines and ten miles of underground cable.

The rapid rate of development is evident from the rise in last year's sales of electricity to 60.2 million kWh, nearly 60 per cent more than in 1954, and the fact that 4,326 new consumers were connected, making the total number served 42,000. There was again considerable development in the use of power for pumping water for irrigation by farmers in the Morphou-Astromeritis area. Last year consumption for this purpose in the area exceeded a million kWh, more than four times as much as in 1954. Works now in course of completion will enable twenty more villages to be given a supply this year and later a further seventy will be connected under the second stage of the electrification scheme.

Tariff concessions were granted in July, 1953, and the Authority says that it is keeping the question of revision constantly under review.

Nuclear Reactor Physics

DISCUSSIONS AT LONDON CONFERENCE

AS reported in last week's issue, Dr. J. R. Dietrich (Argonne National Laboratory) dealt with the physics of advanced reactors in a paper presented at the London conference on nuclear reactor physics. The discussion on this paper was opened by Dr. G. C. Laurence (Atomic Energy of Canada, Ltd.), who outlined the economic factors accounting for the difference in outlook as between the United Kingdom and Canada in their plans for electric power, one being that more than 90 per cent of Canada's electricity was produced by hydro-electric generation at a cost of one-third of a penny per kWh. He said it was believed that by 1965 nuclear power would offer a cheaper alternative to coal-produced electricity in Canada.

Dr. Laurence dealt also with the considerations leading to Canada's choice of type of reactor, and said that Canada foresaw the use of reactors employing natural uranium with enrichment by, first, U235 and, later, plutonium. The first step in their programme was a small reactor, NPD (Nuclear Power Demonstration), which would be constructed at Chalk River and come into operation in about 1959 with a net power output of 18 MW. It was not intended to produce power at competitive costs but to give Canadian industry experience in the design, construction and operation of nuclear power stations and to help in attaining the objective of economic nuclear power by 1965.

Dr. J. V. Dunworth (A.E.R.E., Harwell), said it was held that a fast reactor could produce 50 to 60 per cent more fuel than it consumed. It should be borne in mind that with present designs only 10 per cent of the fuel would be consumed before the fuel needed re-processing, and the loss entailed in the chemical re-processing of the 90 per cent might mean that in the end there was no gain at all. The doubling time for the production of fresh fuel might be five years, and if the fresh fuel formed was not very highly priced, the economic significance of getting a small net gain of fuel would not be great.

While the making of fresh fuel was of great importance, the fact must be accepted that, at least in the near future, it would not be vital to make large quantities of fuel in excess of what one was consuming. The ordinary reactor would have only a small utilisation of uranium, but the fuel need not be wasted. If U238 was stored, it could be a useful fuel in 30 or 40 years' time.

Prof. A. K. Krasin (Academy of Science, Moscow), speaking through an interpreter, referred to the sodium system. He said it was very necessary to know the temperature of the neutron gas in that type of reactor; there were some difficulties in the field of calculations, and further research in physical systems of that kind should be undertaken.

Mr. P. W. Mummery (A.E.R.E., Harwell), referring to Professor Krasin's remarks, said that the view of the A.E.R.E. was that there were many problems to be solved. The work had been described by the president in his opening lecture. He had shown curves indicating the utilisation of uranium in a plutonium-uranium cycle as a function of the various aspects of reactor design. He had shown the dependence of the utilisation upon the temperature of the moderator and, in particular, with the method of calculation and the data used, he had shown that a low neutron temperature would be advantageous from the point of view of the fuel cycle, whereas from an engineering point of view a higher neutron temperature or a higher coolant temperature would result in reduced costs.

Mr. G. R. H. Geoghegan (U.K.A.E.A., Risley) said some things were taken too much for granted. They were inclined to accept the formula for the number of neutrons in the products from a large number of fissions. But it was clear that the numbers of neutrons in the resulting products from individual fissions were not the same. If one could influence the distribution from a type of fission it would result in great advantages. To be able to encourage the occurrence of fissions producing a larger number of neutrons than obtained in the ordinary process would be a great help to the pile designer, and to be able to discourage the occurrence of fissions giving rise to some of the less desirable fission products would be a great advantage to the chemical engineer who designed the separation plant. He appealed for information in that respect.

Australian Plans

Mr. C. N. Watson-Munro (Australian Atomic Energy Commission) said that the most likely type of reactor for Australia would be the British one, PIPPA, which would enable plutonium to be made and fed back into a thorium system. In the early stages it might involve installing large capacity to provide the fissile material which would be required for the Stage 2 and Stage 3 reactors.

Prof. O. R. Frisch (Cavendish Laboratory, Cambridge) opened the discussion, at Wednesday afternoon's session, on the papers by Mr. P. W. Mummery and Dr. L. R. Shepherd. He said it was very impressive how much one could get out of such experimental arrangements as the authors had described and it would be interesting to see how much further these developed. He asked the authors to suggest in which direction the experiments would be extended in the future. In using photographic emulsions, he said, it was surely necessary to be very careful not to over-expose. He also asked for some explanation of the helium 3 spectrometer.

Dr. Shepherd, in reply, agreed with Professor Frisch about photographic plates; the process was a little tedious because they had to be put in very quickly, the reactor

had to be run at very low power and it required hardly any exposure.

With the helium 3 spectrometer they had a proportional counter of about 2in diameter and 6in long in the active volume. This was filled with helium 3. One observed the He_3 (n, p) H_3 reaction at 700 kV plus the instant neutron energy. Pulses coming out of the system were analysed, and one deduced the spectrum as best one could from the analysed pulses. There were two difficulties. If they had neutrons with energies above 1 MeV, then the recoil pulses began to intrude on the reaction pulses and it became difficult to analyse the results. The helium 3 spectrometer tended to break down if they tried to use it for anything but the most degraded spectra—those without many neutrons above 1 MeV. Apart from the wall effects, which were not inconsiderable in such a small chamber, there was the difficulty of the secondary electrons from the gamma radiations.

Dr. Dietrich showed illustrations of a critical assembly used for many of the same type of experiment as Dr. Shepherd had mentioned, and referred also to an experiment connected with the safety of fast reactors. He said it had been postulated that if there were the proper kinds of resonances in the higher energy fission of U235 or plutonium, and if the fissile materials were used without being mixed together with a good deal of fertile material, there was a possibility that the nuclear doppler effect in broadening those resonances could give a prompt positive temperature coefficient of reactivity. An experiment was being conducted, using a helix 235, to see whether they could detect any such coefficient. So far, no effect had been observed, but they had not yet been able to increase the sensitivity of the measurements to the point at which the theory indicated that the effect should be observed.

Research on Shielding

On Thursday afternoon three papers were read: "Shielding for Reactors" by G. C. Laurence, "The Control of Reactors" by A. J. Salmon, and "The Instrumentation of Reactors" by W. Macrae. In the discussion Mr. C. C. Horton (A.E.R.E., Harwell) said that the desire to produce mobile shields and commercially competitive reactors in the last few years had led to an enormous amount of research, especially in the United States. One could see that the theory of gamma ray penetration was now well understood and that the theory of neutron penetration was becoming better understood. The penetration of neutrons in shields containing a fair amount of water could be calculated adequately. The calculation in respect of shields containing very little hydrogen was difficult and not properly understood. An important point in the economics of shields was that it was generally true that the cheapest shield for a large land-based reactor was ordinary concrete. If one plotted the cost of shields as a function of density, there was a sharp increase.

Dr. D. Taylor (A.E.R.E., Harwell), said that at a symposium a few months previously the main emphasis had been on research reactors. That day the emphasis had been somewhat different and there had been references to power reactors. He thought the authors would agree with a comment in a recent paper that the current need in reactor instrumentation was in detector development rather than the transmission and recording of data. It was evident that Mr. Macrae would like to see radiation detectors simplified to cover a wider scale. It appeared to him that some of the electronic circuits which had been referred to had been developed very recently and had still to be tried out on full-scale reactors. It was believed that they were good, but they still had to find out.

Mr. Salmon had given the results of a great deal of computation work, but he had not tackled one important problem, that of deciding on the rates of reactivity addition that it was reasonable to use to have a safe and satisfactorily short start-up. He had not given any quantitative information. There had been emphasis on the need for measuring equipment which worked independently of outside power sources. An electronic amplifier, which was economical in use of power supply and could be independent of outside supply, could be used, and other things could be done.

Mr. M. A. Schultz (Westinghouse Electric Corporation, Pittsburgh) put forward the plea that the matter of the dynamic stability of a reactor should be considered before the reactor design was frozen.

Russian Beryllium Reactor

Russian experiments with a zero-energy reactor based on metallic beryllium were outlined on Friday morning by Mr. A. K. Krasen, a Russian delegate, during the discussion on the papers "Research Reactors and their Uses," by Dr. W. B. Lewis (Atomic Energy of Canada, Ltd.) (read by Dr. G. C. Laurence) and Mr. F. W. Fenning (A.E.R.E.). Mr. Krasen said considerable attention was paid in Russia to the construction of reactors for physical and technical research, and the results of this work were contained in a Russian journal called "Atomic Energy," which would be translated into English. The beryllium reactor had been built with 1,500 kg of beryllium. He showed slides of the reactor; the inner and outer fuel tubes were of steel, and between the tubes was uranium oxide enriched to 10 per cent. The beryllium reactor was made in the form of a cylinder and boron rods were used for control. Turning to reactors working with fast neutrons, he said they had a reactor with an energy of 200 kW, which it was proposed to reconstruct next year to produce 5,000 kW of thermal energy, with sodium cooling.

Mr. J. Bussac (C. E. N. Saclay, France) and Dr. L. Kowarski (Commissariat à l'Energie Atomique, Paris) described the construction in France of a reactor like DIDO, with heavy water, which would give a neutron flux of 10^{14}, but would run at a higher power than DIDO because it was less enriched. It would run at 15-20 MW, the fuel elements would be tubular or cylindrical and the reactor would probably be ready for use by the end of 1957.

Several speakers referred to the need for zero-energy systems to be made available at universities for training, and Dr. Dietrich said that a number of American universities were building research reactors: a water boiler reactor at North Carolina State University, a swimming pool reactor at Pennsylvania State College, and a heavy water cooled type at the M.I.T.

Professor J. Diamond (University of Manchester) said that as knowledge had developed, a need had arisen for higher neutron flux. This need was being met in both Canada and Britain, but it became very expensive to exceed 10^{14} neutrons/cm^2/sec, which was the maximum flux in DIDO and PLUTO. Although the use of higher flux was doubtful at the moment from the technological angle, from the point of view of basic research there was reason to seek higher flux, despite the enormous cost. The cost would be extremely high with solid fuel elements, and it might be that they would have to wait for the development of liquid fuel reactors before making much advance on 10^{14}.

Mr. Fenning, on the other hand, thought there might be a need of a higher flux; he pointed out that 10^{14} at the centre of the core might be reduced to 10^{13} farther out.

VIEWS on the NEWS

By REFLECTOR

MR. E. SHINWELL again came out as an advocate of integration of the fuel industries in the House of Commons last week. He said that "Parliament ought to remove every element of competition from them." Thus once again the former Minister of Fuel and Power resuscitates an idea which has lain dormant for a few months. I have always contended that the only real urge to increase efficiency in the nationalised fuel industries is competition between them. "Integrators" would like to allocate particular functions to coal, gas and electricity. If they were successful each industry would really become a monopoly with little incentive to improve its service and lower its prices. Apart from this, I would like to know who would decide which particular jobs should be done by gas and which by electricity. Some super Civil Servant I suppose.

★ ★ ★

Writing in *The Times* on the need to examine the control and structure of public corporations, Lord Reith stresses the desirability of ensuring that chairmen and members of the governing bodies are not trammelled by having executive functions to perform. In this he is in agreement with the Herbert Committee on the electricity supply industry. Upon the subject of remuneration of boards and executives he goes further than the Herbert Committee by saying that

> "if the present slatternly treatment continues, it will ensure that public corporations are directed and managed by men of second or third grade by civil servants about to be superannuated, or by public-spirited heroes."

I feel sure that in so far as these categories apply to the electricity supply industry the people concerned must fall into the last group.

★ ★ ★

I have already mentioned Mr. Woodrow Wyatt's television appeal to trade unionists to take an active interest in the affairs of their unions, and particularly to vote in elections for officials. Because of this I feel that I ought to mention that members of the Amalgamated Engineering Union have just elected as president, in a second ballot, Mr. W. J. Carron, who was opposed by a Communist, Mr. R. Birch, after the latter had obtained a majority—but an insufficient one—on the first occasion. Whether Mr. Wyatt's broadcast was really effective is, perhaps, doubtful, for the proportion of members who voted, although slightly higher than usual, was still only 12 per cent.

★ ★ ★

Some time ago I referred to the complaint of a critic of the Central Electricity Authority who mentioned that power stations "sprang up during the night." Now the C.E.A. has been accused in the House of Lords of secretly agreeing with planning authorities upon the erection of a 275 kV line from Fleet, Hampshire, to Drakelow, Nottingham. Lord Lucas, who made the accusation, said that

> "had it not been for the energy of reporters of small local newspapers the public would not have been alerted as to how their amenities are going to be desecrated by a a thing like this."

All I can say (as the C.E.A. has in effect said) is that never was a secret so widely known. The erection of this supergrid in secret would be about as easy as putting up a power station overnight. Of course it might be done in America (or Russia).

★ ★ ★

The supremacy of "Tin Pan Alley," Broadway, New York, which has for so long held sway in the field of popular music, is, it seems, threatened. According to the New York correspondent of the *Daily Telegraph*, "Datatron," an electronic brain, has been constructed which it is claimed can produce 1,000 songs an hour. The alarm with which this announcement has been received in "Tin Pan Alley" is shared by me. But why an electronic *brain?*

★ ★ ★

The *Electrical Review* of 13th July, 1906, included an abstract of a paper by Mr. J. F. C. (later Sir John) Snell, chief electrical engineer, Sunderland, read at the annual conference of the Incorporated Municipal Electrical Association. This surveyed the feasibility of establishing an electricity supply undertaking in a small town. The author took as an example a town of 3,400 inhabitants (750 houses) already supplied with gas. Assessing the possible demand Mr. Snell said:—

> "There is the street lighting; 125 street lamps each consuming 60 watts (say, each column having two 'Tantalum' lamps) would compare most favourably with the present lighting. With a cheap method of wiring . . . the local shops, residences, churches and other public buildings would represent an equivalent of 7,500 32-watt lamps installed. Then there are a few tradesmen who would require a small supply of power, for stable machinery, hoists, printing, saws, laundry work, and small machines for butchers, bakers and grocers."

The annual consumption for street lighting was put at 32,850 units and for other purposes at 197,500 units—a total of 230,350 units, or 70 per head. The power plant would have a capacity of 250 kW to meet a maximum demand of 200 kW but the author showed that a supply from a power company would be cheaper. Although the estimate of consumption per head was by modern standards extremely modest the author was criticised for his optimism when the consumption in his own town (excluding traction) was only 21 units per head. Mr. Snell corrected this figure to 28 but still "did not convince his critics."

INDUSTRIAL NEWS

Australian Import Regulations

It was announced by the Australian Government recently that reductions in imports, amounting in value to £32 million sterling in a full year, were to take effect from the beginning of this month. Considerable changes have been made in the import licensing arrangements. Category "B," covering less essential goods, is now divided into seven sub-categories of which "B (1)—Metal manufactures, appliances and equipment" is the one which concerns electrical manufacturers.

Quotas under these sub-categories will no longer be related to imports during the year ended 30th June, 1951, but will be based on the year ended 30th June, 1955, and may be established only by firms which held quotas on 25th June this year. Annual quotas for goods in sub-category "B1" will be reduced by about 25 per cent of the level of licensing of these goods in the quarter ended 30th June, 1956; this represents a quota of the order of 37½ per cent of imports during 1954-55. Annual quotas will still be allotted in four quarterly instalments.

Category "A" (more essential goods) will now cover in addition to all those previously in that category, all goods formerly in "Admin. x" and certain goods previously in Category "B," including clothes-washing machines and wringers, refrigerators and parts, fork lift trucks up to 10,000lb capacity, and elevating platform trucks with elevation under 12in. Quotas for goods already in Categories "A" and "Admin.x" will be based on varying percentages of the previous quotas. For goods transferred from Category "B" quotas will be based on 1954-55 imports and the Board of Trade understands that there will be substantial reductions in quotas for washing machines and refrigerators.

There are no changes in the list of tariff items in the existing "Admin." and "Admin.(W)" categories.

New E.R.A. Journal

Up to the present time the publications of the British Electrical and Allied Industries Research Association have been limited to the annual report and the reports dealing with the results of the many individual items of research, either as interim or final reports. To improve the dissemination of the knowledge acquired by the Association it has now been decided to issue to its members twice a year an E.R.A. house journal entitled "Co-operative Electrical Research." It is proposed to include articles written by members of the staff and others closely associated with the work, reviewing on broad lines various aspects of the different sections of the E.R.A. activities and bringing out the effect of these on practical problems.

The first issue, which has just been published, contains forty pages and includes seven main articles on subjects ranging from radio interference and high voltage transmission systems, to insulating materials and short circuit forces in transformers.

Government to Sell Copper

The Board of Trade proposes to release up to 36,000 tons of copper in the current financial year, and will shortly be discussing with trade representatives how disposals may best be arranged so as to avoid undue disturbance to the market. These consultations are expected to take at least a month, and no sales of copper will be made before the middle of August.

Soviet Trade Delegation

A Trade Delegation has recently arrived in this country in connection with the Soviet purchasing programme which was submitted by Mr. Bulganin and Mr. Khruschev during their visit to London. The Delegation is headed by Mr. V. A. Malyshev, deputy chairman of the Council of Ministers of the U.S.S.R., and includes Mr. Kamensky, the Soviet trade representative in London. Concerns who are interested in the Soviet purchasing programme and who have not already done so, should get in touch with the Soviet Trade Delegation at 32, Highgate West Hill, London, N.6, and should inform the Delegation of the items in the programme which they might wish to supply.

Igranic-Dagnall & Kendall Agreement

Dagnall & Kendall, Ltd., announce that negotiations have now been completed with the Igranic Electric Co., Ltd., whereby they have taken over all Igranic's outstanding commitments for radio and television and various types of transformers, chokes and wire-wound components. In future in addition to their own range of products Dagnall & Kendall will manufacture components similar to those previously made by the Igranic Co., which include both 70 deg and 90 deg time base components, Mullard type deflection and focus coil assemblies for projection and their complete range of wire-wound components.

Radio-Telephone Equipment for Pakistan

Pye, Ltd., announces that a further contract has been signed with the Pakistan Industrial Development Corporation (for the Sui Gas Transmission Co., Ltd.), for the supply and installation of a v.h.f. multi-channel radio-telephone system between Sui and Multan in West Pakistan. The system will provide telephone and teleprinter services along a new pipeline carrying natural gas to Multan, a distance of 200 miles. This contract follows the completion by Pye, Ltd., in 1955 of the communications system for the Sui-Karachi 350-mile pipeline, which is now supplying gas to factories and power stations in Karachi. The radio-telephone equipment for the Sui-Multan pipeline is being jointly manufactured by Pye, Ltd., and Ericsson Telephones, Ltd.

Alternators for Egypt

The Brush Electrical Engineering Co., Ltd., Loughborough, has received an order from Henry Meadows, Ltd., for 200 "Square Path" alternators to the total value of about £70,000. The alternators will be coupled to Meadows engines for sale as generating sets to the Egyptian Government under a contract announced recently by Henry Meadows, Ltd. Each alternator has an output of 26.58 kW, 220 V, at 1,000 r.p.m.

Royal Commercial Travellers' Schools

At the annual court of governors of the Royal Commercial Travellers' Schools held on 18th June the president of the Schools, Mr. Leslie Gamage, M.C., M.A., F.C.I.S. (General Electric Co., Ltd.), referred to an excess of expenditure over income for the last financial year of £14,173. Thus in the last three years a total deficit of well over £35,000 had been suffered. He again emphasised the great need for more financial support through voluntary sources if the board was to carry out its commitments to the boys and girls. The chairman of the board, Mr. Cyril Harvey, also spoke of the serious financial situation.

Mr. Gamage was re-elected president and Mr. G. Hope-Morley treasurer.

Electrical Commercial Travellers

The Electrical Trades' Commercial Travellers' Association has issued the 1956 edition of its booklet setting out the objects of the Association. In a message to members, Mr. W. Candelatt, the chairman, refers to the good work which the older members have done for the Association and appeals for more members to show their willingness to become members of the Committee and to accept office when vacancies occur. Reference is made in the booklet to the inauguration of the North-Western Branch in Manchester, and lists of the principal events in London, the Midlands and the North West are also given. The

booklet includes an application form for membership. Copies of the booklet can be obtained from Mr. P. F. Pike, hon. general secretary, 18, Carew Road, Wallington, Surrey.

Apprentice Registrations

The registration progress report of the Apprenticeship and Training Council for the Electrical Industry gives the following registrations as at 31st May last:—Category 1 registrations, 3,340; Category 2, 11,466; total, 14,806. This is an increase respectively over 1955 of 700, 2,488 and 3,188. Category 1 apprentices are those serving under a deed of apprenticeship approved by the Council; Category 2 are youths engaged on an understanding that, provided they are industrious and of good conduct, they will be retained by the employer for the full period of Category 1 and given the same facilities, and on completion will receive a letter or certificate indicating that they have satisfactorily served their term of apprenticeship.

Floor Heating in a Tweed Mill

Underfloor low temperature radiant warming has been adopted in a new tweed mill at Easthouses, Dalkeith, opened by Wilson & Glenny, Ltd. Aluminium cable housings are laid on the structural floor and covered with expanded metal which acts as a heat diffuser. These cable housings terminate in steel access troughs at each end of the building and are flush with the finished floor level. The total loading is 120 kW.

New Electric Furnace Company

The formation of a new company under the title of Efco-Edwards Vacuum Metallurgy, Ltd., is jointly announced by Edwards High Vacuum, Ltd., of Manor Royal, Crawley, Sussex, and the Electric Furnace Co., Ltd., of Queens Road, Weybridge, Surrey. These two companies have for some time been working together on vacuum metallurgical problems. The first products of the new company are a range of vacuum melting and pouring furnaces designed for research and production, as well as other standard plant for sintering, brazing, annealing and degassing metals.

International Tin Council

The International Tin Agreement came into force on 1st July and the first meeting of the International Tin Council began in London on 2nd July. The Council was welcomed by Mr. Peter Thorneycroft (President of the Board of Trade), who pointed out that the agreement was the first international agreement since the war which provided for a buffer stock. It had the advantage of being representative of both producing and consuming countries and of being compatible with the existing machinery for trading in tin and in particular the international tin market. Very great public interest would be shown in the working of the buffer stock which, he hoped, would prove successful in stabilising prices to the common benefit of consuming and producing countries. The meeting was attended by representatives of Australia, Belgian Congo and Ruanda-Urundi, Belgium, Bolivia, Canada, Denmark, Ecuador, France, India, Indonesia, Federation of Malaya, the Netherlands, the Federation of Nigeria, Spain and the United Kingdom. The Council selected M. Georges Peter as chairman.

Operational Research

The National Joint Advisory Council for the Electricity Supply Industry recently approved a scheme of training in operational research. The scheme provides for (1) those employed in operational research sections of the Divisions for a short course of formal training in the techniques and philosophy of operational research, followed by training on the job; and (2) those not directly employed in operational research sections, but who will be most closely concerned with the practical use of the new procedure, should be acquainted with the broad principles as soon as possible. Methods of doing this include: (a) reference to the problems of operational research in existing courses for technical and manual supervisors at the residential training centres; (b) a national course in the principles of operational research for station superintendents and others at managerial level; and (c) local courses, conference and lectures for different groups of employees and in certain cases attendance at courses arranged by local technical colleges.

Telephone Service for Isolated Areas

One of the first "Country Sets"—the v.h.f. battery operated radio-telephone designed by Automatic Telephone & Electric Co., Ltd., for use in isolated areas—to be commissioned overseas went into operation recently on a rubber estate in Sarawak. The estate, at Sungai Tengah, about twelve miles from the capital of Kuching, is isolated by dense tropical jungle swampland, which makes the laying of conventional telephone landlines impracticable, and the "Country Set," with its extremely low power consumption which enables it to be operated for long periods from a 12V battery, is ideally suited for these conditions. The radio link is terminated on a switchboard at the central exchange in Kuching. The hermetically sealed transmitter/receiver unit measures only 15in by 10in by 6in and this compactness has enabled it to be mounted midway up the 40ft aerial mast, thus reducing the risk of damage. The high mast was necessary in order that the four-element Yagi aerial should be well clear of the surrounding jungle. The 12V batteries used are housed in a waterproof box at the base of the aerial mast.

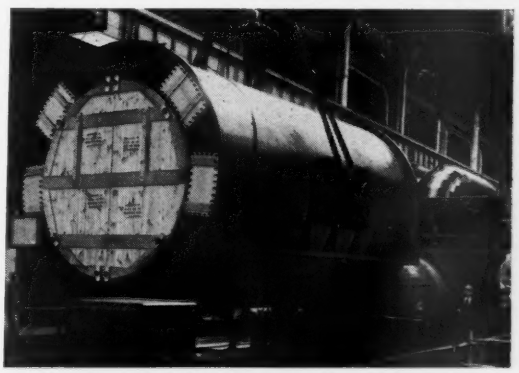
An aerial mounted 140ft above ground level is being used at the Kuching central exchange so that when other stations among isolated communities round about become operational they will work into a common omni-directional aerial. This arrangement will mean a considerable saving in the terminal equipment required.

Careers Booklet

A new fully illustrated booklet, "Fitters, Turners, Machinists," has been published by the Central Youth Employment Executive. It will appeal mainly to boys who are keen on the practical side of engineering. The descriptions in the booklet are based on a typical scheme of apprenticeship training in which a boy specialises in fitting or turning or metal machining after spending about a year in an apprentice school. The booklet is one of a group dealing with occupations in the engineering industry and is written primarily for boys. It will, however, be of interest to parents, teachers and others concerned with the careers of young people. It is No. 64 in the "Choice of Careers" series, and is obtainable from H.M. Stationery Office, price 1s 6d.

Generating Plant at Brunswick Wharf

The accompanying photograph shows the No. 6 turbine-generator set being erected at Brunswick Wharf (Poplar) power station (C.E.A., London Division), the generator stator having recently arrived on site from the Trafford Park Works of Metropolitan-Vickers Electrical Co., Ltd. With the completion of this set Brunswick Wharf will have a total capacity of 330 MW,



No. 6 turbo-generator in course of erection at Brunswick Wharf generating station

made up of four 25.5 MW sets and two 60 MW sets, all manufactured by Metropolitan-Vickers. All the sets run at 3,000 r.p.m.; the four 52.5 MW generators are air cooled and the two 60 MW generators hydrogen cooled.

Vehicle Lamp Price Reductions

Thorn Electrical Industries, Ltd., announce reductions in the price of 24 V lamps for commercial vehicles as from 2nd July.

Reductions in the price of this class of lamp by E.L.M.A. companies were reported in last week's issue.

Fuel Efficiency Exhibition

Ways in which industry can save up to one-fifth of fuel costs—often a great deal more—will be on show at the Fuel Efficiency Exhibition which is being held at Olympia, London, from 2nd to 10th October. The exhibition will be opened by the Minister of Fuel and Power, Mr. Aubrey Jones, and will be the largest of its kind.

Altogether about 150 of the leading firms will be showing special equipment for fuel economy in all branches of industry which will include the latest types of fuel burning devices for both solid and liquid fuel; self-contained, automatically-controlled, oil-fired boilers; the latest developments in insulating materials; and a comprehensive range of automatic-control equipment.

In addition, the Central Electricity Authority, with the aid of photographs, diagrams and models, is giving details of the most recent developments in the plan to construct 12 nuclear power stations by 1965 and there will be an exhibit by the U.K. Atomic Energy Authority illustrating the progress made in the use of nuclear power for peaceful purposes.

During the course of the Exhibition the Institute of Fuel is organising a series of talks and discussions on the efficient use of fuel in industry. Each session will start at 10 a.m.

Trolley-bus Electronic Counter

An electronic counting device, developed by Hadley Telephone & Sound Systems, Ltd., is being tested on a double-deck trolley-bus in Hull. The vehicle has two staircases, one for entry and the other for exit, and two indicators are placed to give to driver and intending passengers information of the number of vacant upper-deck seats. As passengers enter and leave, the number shown on the indicators is automatically adjusted.

Hospital Fire Alarm System

A new and foolproof system of fire alarm and indication has recently been supplied to the Northern Ireland Hospitals Authority to meet the needs of hospitals where buildings are scattered over a large area. Developed by Siemens Brothers & Co., Ltd., in co-operation with Mr. H. F. Harris, A.M.I.Mech.E., of the Hospitals Authority, the system is designed to work in conjunction with the existing private telephone networks. Operated by dialling "999," the main feature of the system consists of an indicator panel laid out as a formalised map giving the positions of buildings and roads. The originator of an alarm is indicated by a lamp on the indicator panel which shows the building block and floor affected. A distinct colour is used for each floor.

The system works on the primary and secondary alarm principle. When an alarm is initiated, only a local alarm is sounded in the fire station or duty room. A circuit is then prepared at the discretion of the duty officer for sounding of a general alarm.

Exhibition Ship

With a view to furthering British exports to the Caribbean and South America, it is proposed by Export Trade Ships, Ltd., to operate a floating mobile showroom in the form of a converted 500-ton luxury yacht on a coastal cruise around the Latin-American ports. It is hoped that all classes of consumer goods will be represented, including refrigerators and other electrical domestic appliances.

Further particulars may be obtained from the offices of the sponsoring company, 1, Fitzroy Street, London, W.1.

Asian Engineers' Visit

As part of a tour which began in India on 27th June and will include several European countries as well as the United States, a group of engineers from Asian and Far Eastern countries is visiting Great Britain for six days (26th-31st July).

The trip has been arranged by the United Nations Technical Assistance Administration in collaboration with the United Nations Economic Commission for Asia and the Far East. The purpose is to enable the experts to study the latest technical developments in power system design, operation and maintenance with a view to their adoption in electric power developments in Asia and the Far East. Particular attention will be given to the use of low grade fuel such as lignite in thermal power stations, the design of underground hydro-electric power stations, the use of small hydro-electric stations in hilly rural localities, the interconnection of large hydro and thermal power stations, high voltage lines, etc.

The visit to the United Kingdom is being sponsored by the Foreign Office. The Central Electricity Authority and manufacturers are co-operating in providing facilities for visits to technical installations and for discussions. Administrative arrangements for the visit are being made by the British Council.

The twelve members of the group will be accompanied by Mr. H. S. Kulkarni, chief of the Electric Power Section of the United Nations Economic Commission for Asia and the Far East, and by Mr. S. Lalander, technical director of the United Nations Technical Assistance Administration.

Signalling Cables for Railway Electrification

W. T. Henley's Telegraph Works Co., Ltd., is supplying and installing over 44,000 yards of multicore rubber insulated signalling cables for the Shenfield-Southend railway electrification scheme. The cables are of screened construction, to British Railways specification, the number of cores varying between 19 and 48. Many of them are provided with a fireproof finish.

Annual Holidays

The Southend-on-Sea works of E. K. Cole, Ltd., will be closed for the annual holiday from 21st July to 6th August inclusive. Sales and service facilities will be available during this period.

The works of the Elkay Electrical Manufacturing Co., Ltd., 42, Woburn Place, London, W.C.1, will be closed for the annual holidays from 21st July to 7th August.

Trade Announcements

The address of Mr. R. S. Montgomerie, London manager of the **E.M.B. Co., Ltd.,** West Bromwich, is now 10, Woodside Road, Northwood, Middx (telephone: Northwood 2159). Mr. L. Hopwood has been appointed Scottish area representative of the company in place of Mr. T. C. Sharp, who has resigned. Mr. Hopwood's area will cover the North East Coast, Scotland and Ireland. His office address will be 75, Bothwell Street, Glasgow, C.2 (telephone: Glasgow Central 2280).

The **English Electric Co., Ltd.,** announces that Kelly & Shiel, Ltd., United Works, Distillery Road, Dublin, N.E.2, who have acted as its distributors for electrical domestic equipment for the past eight years, have been appointed agents in Southern Ireland for the complete range of the company's engineering equipment manufactured at the Stafford, Bradford and Liverpool works. Kelly & Shiel, Ltd., will have the technical advice in Eire of Mr. L. A. Fry, who is already well known in the territory.

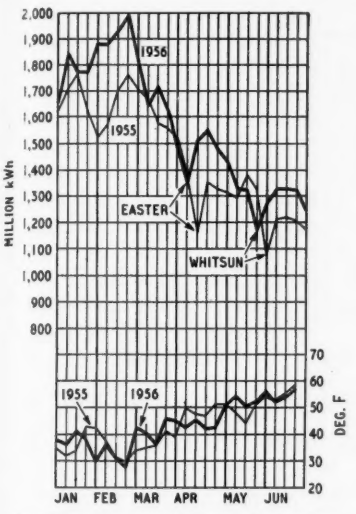
Midland Silicones, Ltd., has appointed Holiday & Hemmerdinger, Ltd., 74-78, Hardman Street, Deansgate, Manchester, 3, as its distributors of silicone electrical insulating compound MS4 in Lancashire, Cheshire, Denbighshire, Flint, Westmorland and North Staffordshire.

J. Day & Co. (Derby Works), Ltd., have opened a depot at 35, Robertson Street, Glasgow, from which their range of cables can be obtained. The depot is in the charge of Mr. L. C. McCrone.

GENERATION AND DEVELOPMENT

Output of Solid Fuel Stations

The Ministry of Fuel and Power's latest weekly statistical statement shows that in the first half of the year 40,808 million kWh was sent out for public supply from solid fuel fired generating stations. Compared with the first 26 weeks of 1955 (37,805 million kWh sent out), there was an increase of nearly 8 per cent. The average temperature up to the third week in June this year was 44 deg F (43.8 deg in the corresponding period of last year and an average of 46.2 deg for the 30 years from 1921 to 1950).



Output curves of solid fuel fired power stations for the first 26 weeks of 1955 and 1956 together with average weekly temperatures

Coal consumption at power stations up to 23rd June last amounted to 22.9 million tons as compared with 21.5 million tons up to 25th June, 1955. Coal stocks at power stations were substantially more than a year ago, namely, 6.4 million tons (equal to 5.6 winter weeks' consumption) against 4.6 million tons (4.6 weeks' consumption) last year.

Electricity on Holy Island

Proposals for the supply of electricity to Holy Island, off the Northumberland coast, are to be the subject of a Ministry of Fuel inquiry on 17th July. The work is being held up on account of a conflict between the Electricity Board and the Planning Authority on the use of overhead or underground cables. The Board proposes to use a submarine cable from the mainland, but overhead lines on the island itself.

Baldock Service Centre

The first consumer to use the new Service Centre of the Eastern Electricity Board at Baldock "jumped the gun" by paying her account to Miss Maureen Lyons, who is in charge, before the chairman of the Urban District Council had officially declared the showroom open. It was, in fact, the necessity to provide some place at which accounts could be paid direct that first prompted the Board to seek premises in the town. Clever decorations and some slight structural alterations to a shop in the High Street bought by the Council and let to the Board have enabled the district manager (Mr. H. L. Sumner) and the district commercial engineer (Mr. R. H. Halls) to display the latest electrical apparatus in a modern setting and to provide a comfortable demonstration room.

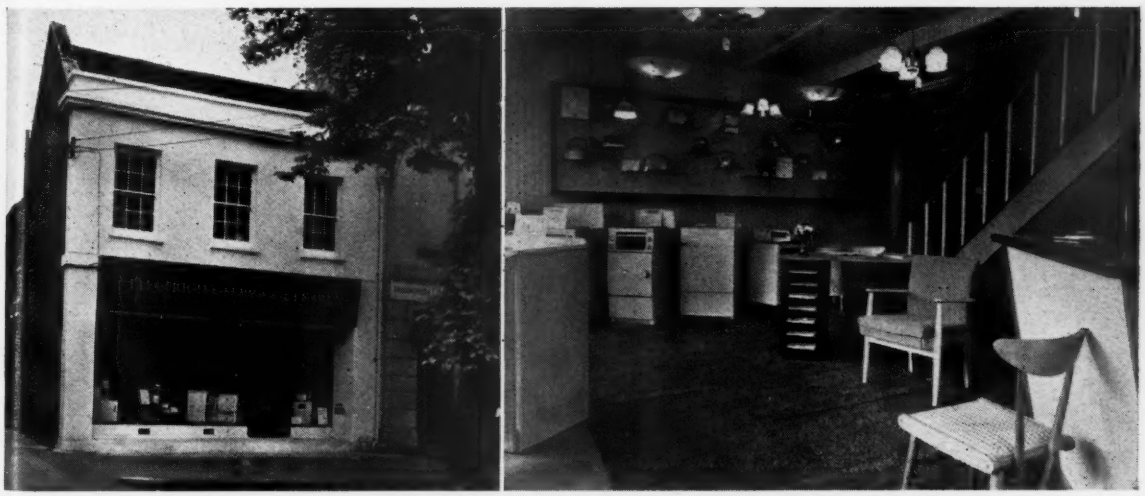
Mr. Sumner, in introducing the chairman of the U.D.C. (Mr. E. Stevenson), said that when the Board took over the undertaking there were three to four thousand consumers; there were now seven thousand. He presented Mr. Stevenson with an electric alarm clock and Mrs. Stevenson received a bouquet of carnations from Miss Lyons. Mr. C. C. Hill, manager, and Mr. S. W. Hazel, commercial officer, of the Northmet Sub-Area, and Miss E. M. Yetton, senior housecraft adviser, were also present.

North of Scotland Tariffs

Last February the North of Scotland Hydro-Electric Board announced that it had no intention during the current financial year of raising its tariffs. Reaffirming that decision Mr. Thomas Johnston, chairman of the Board, said recently that any exceptional increase in costs involving the Board in losses, for example the increase in interest rates on money and loss of revenue due to abnormal drought, would be carried forward to another year.

Langdale Valley Decision

By eleven votes to four the Lake District Planning Board last week approved a recommendation of the Development Control Committee that the final 1½ miles of the electricity cable to supply the head of Langdale Valley should be overhead except for two sections of 200 yards and a quarter of a mile. This followed the defeat of an amendment that the whole line should be underground. Mr. J. W. Major, of Ambleside, supporting the amendment, said that the Electricity Board's "credit squeeze" economising on rural electrification was a scandal. Letters were read from Lord Strang (chairman,



The new Baldock Service Centre and a view of the interior

National Parks Commission) and from representatives of the National Trust, the Friends of the Lake District and the Council for the Preservation of Rural England all urging that the entire line should be underground as originally agreed.

East Devon Rural Scheme

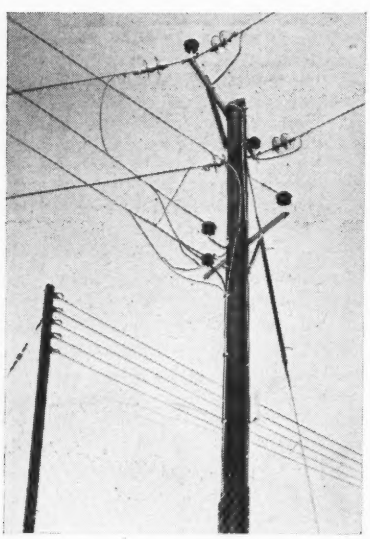
One of the South Western Electricity Board's largest rural electrification schemes to date was completed on 4th July when supplies were made available to Talaton, Westwood and Talewater, in East Devon, including the villages of Clyst Hydon, Clyst St. Lawrence and Aunk. Fifty-nine farms and 160 other properties in the district are being served.

This development will help to complete a ring main by which consumers at Plymtree, Broadhembury and Awliscombe will have an alternative supply during any breakdown of their normal source. A start will soon be made on the installations for Cotleigh and Southleigh.

11kV Trailing Cables

The South Western Electricity Board has been experimenting in Cornwall with polythene insulated 11kV trailing cable for use during shutdowns to provide temporary supplies. The results have been so encouraging that it was decided to use this cable to provide supplies and to by-pass the existing 11kV overhead line traversing the showground at the Royal Cornwall Show at Helston this year.

About 900yd of cable supplied by the Sterling Cable Co., Ltd., was run out along the foot of the hedges around the showground, being buried in the ground at only a few places along its route. Where the cable was buried at a gateway in the hedge, for example, it was laid to a depth of 18in. To provide maximum protection for the cable it was laid on a bed of sand at the bottom of the trench, covered with more sand, and finally protected by cable tiles before the trench was filled in. The cable was fenced off along the whole route by a simple rope fence.



As may be seen, the cable is merely cleated up the pole and connected to the bare copper connections between the transformer pole and the cable pole. The bare ends of the cable between the line taps and the insulation are taped with polythene tape. The copper braid sheath of the cable is bonded to earth

Cookers in Council Houses

It was reported to the Eastern Electricity Consultative Council last Friday that at a recent meeting of the Consultative Council chairmen with the Minister of Fuel and Power the question of the effect of restrictions on hire purchase and simple hire on the provision of cookers for council house tenants was raised. Information had now been received from the Ministry of Housing and Local Government that if a local housing authority wished to provide cookers in new houses the necessary loan consents for the cookers would be issued with the loan for the provision of the dwellings. Ald. W. J. Bennett, C.B.E., J.P., chairman, said that this was an important decision as hire-purchase deposits on equipment for a house could be quite a burden to a new tenant.

Boarding House Tariffs

At the same meeting of the Eastern Consultative Council Ald. Bennett said it was understood that the Retail Tariffs Committee had practically completed its deliberations on tariffs for boarding houses, small hotels, etc., and it was expected that the Committee's proposals would be submitted to the Area Boards shortly.

Freedom of Choice Restored

Following representations by the North Eastern Electricity Board, the Wallsend Town Council has agreed to restore its scheme for providing facilities for both gas and electric cooking in new Council houses. Some months ago the Council approved the principle of using only gas for cooking, but the Electricity Board protested that this would make the supply of electricity to new houses uneconomic.

Higher Charges in Eire

A report from Dublin states that the Electricity Supply Board has applied to the Prices Advisory Body for permission to increase electricity charges.

Electricity in Lagos

An article on improved electricity supply in Lagos published in the *Nigeria Trade Journal* includes a detailed description of the Ijora "B" power station opened by H.M. Queen Elizabeth last February. Although electricity in Lagos, and in fact in Nigeria, dates back to 1898, development was only haphazard until 1921, when the Ijora "A" station was built on Iddo Island, the plant consisting of a number of 300 kW and 1,000 kW alternators driven by reciprocating steam engines. The first steam turbine set was installed in 1939, the second in 1942 and the third in 1945, the original sets being moved to Enugu and Abeokuta where they are still working.

By the end of the 1939-45 war the peak load in Lagos had reached 4,000 kW and was rapidly increasing. The high voltage distribution system was operating at 3,300 V but it was realised that this would be insufficient to meet future needs. In consequence, the voltage of the existing installation was doubled during the years immediately following the war and the system was simultaneously expanded and reinforced. The furthest point to which the supply was extended was Iju waterworks, some sixteen miles from the power station on Iddo Island; the peak load was raised to just under 16,000 kW.

The expansion of demand was such that it had for some time been clear that a further major power station was required. The "B" station was therefore built, the site being on reclaimed land at the side of Lagos lagoon, approximately 500 yards to the east of the "A" station. The consultants for the station were Messrs. Preece, Cardew & Rider and the main contractors were Babcock & Wilcox (boilers), the Brush Electrical Engineering Co., Ltd. (turbo-alternators), A. Reyrolle & Co., Ltd. (switchgear) and Johnson & Phillips (cables). The initial installation consists of two 12,500 kW sets and it is planned to extend the station by two 30,000 kW sets.

Madras Hydro-Electric Scheme

It is reported that the Canadian Government is to provide assistance to India under the Colombo Plan to help finance a hydro-electric scheme on the Kundah River in Madras.

Kariba Engineering Contract

The Central Africa correspondent of the *Manchester Guardian* says that the Federal Power Board has announced that it will not publish the name of the successful tenderer for the main engineering contract for the Kariba hydro-electric scheme until later this month. Previously it had been reported in the local Press that the contract had gone to an Italian company, Impresit, at a price of £22-23 million. The lowest British tender was said to be at least £2 million higher than that, and £1 million higher than the figure submitted by an American contracting organisation. The correspondent says it is believed that the Board has decided to delay its announcement on the main contract until it has taken a decision on the remaining contracts which include turbines and electrical equipment and "British firms are backed to be largely successful in these fields."

Engineering in Europe

ABSTRACTS FROM FOREIGN TECHNICAL JOURNALS

THE concept of "climatisation" of electrical equipment is not only so far not general knowledge among electrical engineers, but not even well enough defined. This is partly due to the fact that the scale of "macro-climates" all over the globe is very wide indeed, therefore a very great variety of intrinsically different conditions exists; and partly to the fact that the importance of the strictly local, or what is called "micro-climate" can easily escape attention. It is much easier to list the physical conditions which have to be taken into account, viz., temperature and humidity of the ambience (particularly their extremes), radiations and dust contents (as well as nature or composition) in the atmosphere, vapour pressure, fog, snow and ice incidences, etc.

All these data must be taken from meteorological reports and statistics and reflect, as a rule, the macro-climate, whereas the micro-climate will mostly have to be determined specially by measurements *ad hoc* and extended over longer periods. When the main data are known, they can mostly be reproduced closely enough in tropicalisation laboratories. It is obviously also important to know whether the equipment is for indoor or outdoor use. Given all the information he needs, the designer will nowadays generally be in a position to select his materials exactly to meet the given conditions, severe though they may be, and to decide on fully enclosed, or even hermetically sealed constructions if required. However, it is necessary that the attention of electrical engineering students should be drawn to this important problem at an early stage of their training.—"The Consideration of Climatic Influences in the Design and Construction of Electronic Equipment," E. Ganz and K. Michel, *A.S.E. Bull.*, Vol. 47, No. 10, pp. 441-458, 12th May, 1956, in French.

Noise in Electrical Machinery

It may be granted that in our noise-ridden age the noises due to electrical machinery do not represent a major nuisance, since they are at the very worst still of comparatively low intensity, but their persistent character may render them very trying in certain unfavourable conditions, and particularly where they form an acoustic background on which the usual traffic noises, etc., are superposed. Also, the noises of electrical machines and apparatus have different origins, viz., mechanical, magnetostrictive and electromagnetic excitations, and therefore distinct characteristics.

There is now a considerable body of information available about the various groups of electrical machine noises and partly, e.g., where they are due to transverse and torsional vibrations of shafts, or bearing noises, they are identical with noises produced by non-electrical rotating machinery. Magnetostrictive noises, on the other hand, can obviously occur only in electrical machines, and as transformer-hum which, however, becomes troublesome only if the electrostrictive vibrations are in resonance with natural frequencies of parts of the transformer structure. Electromagnetic, or, rather, electrodynamic, noises occur particularly in turbo-generators, and methods for suppressing these were successfully developed in the U.S.A. by radially sprung suspension of the stacks of stator stampings. In general it may be said that most of the noises can be greatly reduced and often suppressed if their origin is correctly diagnosed and the frequency spectrum of the machine analysed.—"Problems of Structure-Borne Sound in Electrical Machine Construction," E. Lübcke, *Akustische Beihefte*, No. 1, pp. 109-114, 1956, in German.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

Synchronous Condenser Problems

The maintenance of the static stability of h.v. long-distance transmission systems requires, in addition to longitudinal compensation, the use of synchronous condensers for voltage stabilisation at intermediate points of the line. In the case of powerful systems, such as the 400 kV Kuibyshev-Moscow transmission, the installed power of these intermediate synchronous condensers becomes very large. This may, however, be reduced by compensating the transient and subtransient reactances of the synchronous condensers by static capacitances.

The authors present a theoretical and experimental analysis of the actual conditions, yielding the surprising result that the degree of compensation required for reasons of stability is difficult to apply to the conventional design of synchronous condensers with damper windings and that a better way is probably to control the excitation for improving the stability, unless a new design of synchronous condenser particularly suitable for strong compensation of the transient reactance is made available.—"Cumulative Hunting and Self-Excitation of Compensated Synchronous Compensators," Yu. A. Rozovskii, E. A. Marchenko and V. A. Andreyuk, *Elektrichestvo*, No. 5, pp. 59-63, 1956, in Russian.

Contact Wear

Investigations on contact wear of starters and electromagnetic contactors must always distinguish between wear on circuit-making and breaking, and also between electrical and mechanical wear. Most authors agree that wear on circuit-breaking exceeds that on making 4-5 times and also that the length of the "bouncing" period is the most important criterion of the contact wear on circuit-making. This was again confirmed by tests with an inertia-free electronic measuring circuit for the "bouncing" time, which is particularly suitable for determining the influence of the various parameters of the starter design and of production quality on the "bouncing" period. Reduction of weight and speed of the moving contacts and increase of the initial contact pressure will effectively reduce the "bouncing" period. Contact weight reduction may be achieved by reducing the cross-section of the contacts within the limits imposed by considerations of mechanical strength and thermal stability under short-circuit conditions. In rotary contactors contact speed reduction and increase of initial pressure may be achieved by arranging the contacts nearer the axis of rotation. Contact wear is lower in contactors with electromagnets of the three-limb type than with T-magnets.—"Improvement of the Wear Resistance of Starter Contacts," R. S. Kuznetsov, I. N. Ermolaev and S. V. Gamlitskaya, *Elektrichestvo*, No. 5, pp. 43-45, 1956, in Russian.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

How Low is a Safe Voltage?

I WAS unfortunate enough to miss Mr. Gilbert's article in your issue of 25th May at the time of publication. Since my name has been mentioned, however, perhaps he will forgive the delay in offering a few observations.

Mr. Gilbert says that 110/55 volts does not really achieve safety, "for the simple reason that at this voltage the vulnerable earth conductor in the flexible lead must be retained," and he goes on to make the somewhat curious claim that "with the loss of this essential link in the safety chain the 110 V tool would appear to be no safer than the 240 V tool"; in fact he says it may be less safe. We are thus, in fact, asked to believe that 55 V is as dangerous as 240 V. While no experienced engineer would claim that 55 V is completely safe, experience of the extending use of the 110/55 V system has failed so far to produce a record of a single fatality or even serious shock; in comparison the use of 240 V is still responsible for more than 40 per cent of the total electrical fatalities in factories. In mines, where portable apparatus may not be used on a voltage exceeding 125 V, the record is also satisfactory.

In view of this experience, and bearing in mind that the effect of shock at 240 V is seriously aggravated by the lower resistance of the body at that voltage, as compared with its resistance at voltages in the neighbourhood of 55, I find no little difficulty in understanding Mr. Gilbert's argument. It might further be mentioned that the incidence of breakdown with low voltage tools is less as a result of their more robust electrical construction.

In discussing the 50/25 V system Mr. Gilbert says that economic considerations appear to be insurmountable unless the system is limited to a small area. Some of the largest firms in the country, whose engineers would hardly risk their reputations on an uneconomic installation, have employed this scheme with success throughout their factories. The question of cable size for l.v. systems is not, in fact, a serious one in practice if the transformers are intelligently arranged (America has so far managed on 115 V).

Mr. Gilbert's reference to the use of a direct earth preventing the operation of the voltage-operated earth leakage breaker may be a little misleading since, if the earth connection from the operating coil is taken to an auxiliary earth electrode, interference from the main earth (which is required by law) does not occur.

The need for a direct earth is supported by many instances where such trips have failed to operate. There are also circumstances, as Mr. N. Elliott showed in his paper to the Institution of Electrical Engineers a few years ago, and to which I alluded in the earthing articles to which Mr. Gilbert refers, where the distribution of voltage between the substation and factory will inhibit the operation of a voltage-operated trip.

London, W.4. F. H. MANN, M.I.E.E.

Electricity Meters

WITH reference to the comments by "Reflector" in your issue of 20th April last concerning the information obtained from an article in *London Electricity* by Mr. H. S. Petch, of export prices of meters from Eastern Europe, it may be of interest to your readers to know that my Board has recently received a quantity of East German meters of the house service pattern, rated from 3 to 20 A at 30s each c.i.f. Admittedly, the quality is not that of the British meter we have imported heretofore but at the same time it satisfies the test requirements of the British Standard Specifications. It is very difficult to argue that the British meter at £3 2s 6d each f.o.b. is the better "buy."

One point that must be borne in mind is that an average consumption of electricity among the working and lower middle classes of this country, and I should imagine of many other Asiatic countries, is some 12 kWh per month only, and that the incurring of heavy capital expenditure on service cables, meters, service fuses and such devices as earth leakage circuit breakers is quite out of the question.

Rangoon, Burma. C. H. MELLOR, M.I.E.E.,
Chief Engineer,
RANGOON ELECTRIC SUPPLY BOARD.

Formula for Estate Supplies

LAST September a meeting was held at the Ministry of Housing and Local Government on the subject of electricity supplies to housing estates and since then discussions have continued between representatives of the Electricity Boards and of the local authority associations on the wording of a working formula. This formula would form the basis for negotiations between Boards and local authorities in England and Wales for contributions towards the cost of connection of electricity supplies to Council housing estates.

The formula which the Boards have indicated that they will be prepared to follow until further notice provides that, except in cases of abnormal cost and difficulty, no contribution will be required towards the cost of taking a supply to an estate (other than the cost of service lines and connections) if the electrical installations are of a specified minimum standard and tenants have freedom of choice of appliances to the extent set out in the formula.

The minimum standard of wiring for a normal three-bedroomed house, in addition to lighting, includes power points in living room, dining room, kitchen, wash house (if provided) and in two of the bedrooms, with another either on the landing or in the third bedroom. There must also be a cooker circuit in the kitchen and wiring and power point for an electric immersion heater or thermal storage water heater in the airing cupboard or other suitable position, with a metal boss on the water tank for the fitting of an immersion heater.

The first tenants are to have freedom of choice between electrical and other appliances and no obstacle is to be placed in the way of a subsequent tenant who wishes to change to electricity, but the local authority will be under no obligation to provide electrical appliances except in cases where they are available from a previous change. Where the first tenant wishes to cook by electricity the local authority will provide a cooker control unit.

Where there are solid fuel heating appliances, or a central heating system for a number of houses or flats, any supplementary electric space heating will be provided by the tenant.

PARLIAMENTARY REPORT

IN the House of Lords, Lord Lucas of Chilworth asked if the Government was aware of the proposed erection of a 275 kV supergrid electricity line from Fleet in Hampshire to Drakelow in Nottinghamshire which would be carried through some of the most beautiful of England's countryside on pylons 136ft high, spaced 440yd apart; under what powers it was being erected; and under what powers it could be stopped.

The Earl of Munster, Minister without Portfolio, said the Government had received no formal application for this proposal. However, he had been informed that the Central Electricity Authority was now drawing up its first plans for this part of the 275 kV grid which was the new main transmission system designed to provide improved electrical connections between various parts of the country.

Before erecting a line of this kind the C.E.A. must apply to the Minister of Fuel and Power for his consent and the Minister was required to give the local and planning authorities affected an opportunity to be heard. The views of the bodies concerned with the preservation of amenities were also taken into account. Where the Minister considered it advisable he could arrange for a public inquiry to be held.

Lord Lucas said that the scheme had been agreed by various planning authorities who sat in secret. If it had not been for the energy of the reporters of small local newspapers the public would not have been alerted about the way their amenities were to be desecrated.

The Earl of Munster said there were ample provisions for the local hearing of objections.

Lord Lucas asked what was the good of an inquiry when the whole thing was a *fait accompli* and the line was almost erected.

Reduction in D.S.I.R. Vote

In the debate in the House of Commons on economic conditions, Mr. Harold Wilson complained that the Government's proposed economy cuts included a reduction of £150,000 in the vote for the Department of Scientific and Industrial Research. He said it was an extraordinary economy to introduce at a time when Ministers kept reminding the people that the country was facing a new battle of survival which would be fought out in the factories and the laboratories. In its last report, the D.S.I.R. made it plain that from almost every corner of the country had come demands which entailed further expenditure; it had said the resources available were likely soon to be inadequate. It had listed the Industrial Grants Committee, the Scientific Grants Committee, and the Nuclear Physics Committee as having asked for more money. Now the Government came along and slashed the estimate.

Mr. Wilson said the London County Council had been instructed by the Minister of Education to treble their fees for advanced education. How did this tie up with the Minister's drive for increased technological education and the rest? The Minister of Labour had recently been sacking unestablished factory inspectors—men specially recruited during the war who had been 10 or 12 years on the job—yet the Government had complained that between 50 and 70 per cent. of British factories had no adequate fire warning system.

Mr. Bevins, in a written reply to a question, stated that the reduction of £150,000 in the estimate for the D.S.I.R. would be attained by these means: £33,000 from staff reductions, £20,000 from a reduction in grants for industrial research, £49,000 from economies in purchases of equipment and consumable stores, £20,000 from delaying the start of a new borehole for the geological survey, and £70,000 from increasing test fees and similar charges. These economies totalled £192,000, but must be offset by increased expenditure of £42,000 on scientific grants (£37,000 for nuclear physics, and £5,000 for other grants).

Joint Use of Poles

Mr. Alport, Assistant Postmaster-General, informed Mr. Speir that in Northumberland about 29 miles of telephone cable was carried on poles which were employed jointly for the distribution of electricity.

Mr. Speir asked if that was not a disappointing total. Was it not quite feasible to carry both electricity and telephone cables on the same poles? He suggested that the Post Office engineers in Northumberland should consult the Electricity Boards about it because too many people in rural areas were still waiting for both telephone and electricity services.

Mr. Alport said that the Post Office was in process of negotiating with the Electricity Boards in all parts of the country about the sharing of poles and pylons. During the year ended 31st May, 1955, that policy was carried out on 6,000 new installations involving the joint use of 15,000 new poles. In some circumstances, however, for reasons of danger and interference with the telephone service this was not possible.

Interference from Motor Cars

Replying to Mr. Brockway, Mr. Hugh Molson, Parliamentary Secretary, Ministry of Transport, said the Postmaster-General already had powers to require motor car owners to fit suppressors to their vehicles, and new motor vehicles must be so fitted. He had no power to make the issue of an excise licence conditional on the fitting of a suppressor.

Power Station Dispute

Mr. Parker asked the Minister of Labour what progress had now been made in settling the dispute at the Tilbury power station.

Mr. Macleod said that following the discussions at national level to which he had referred on 14th June arrangements had been made for the matter to be considered further at a local meeting between the officers of the unions, the firm and the employers' association in accordance with the recognised procedure in the industry.

Clean Air Bill Passed

The Lords amendments to the Clean Air Bill were agreed to when they came before the Commons for approval, and the Bill received the Royal Assent on 5th July.

Fuel and Power Investment

During the Committee stage of the Coal Industry Bill, Mr. Aubrey Jones, the Minister of Fuel and Power, moved an amendment to define as five years the period of the borrowing powers conferred on the National Coal Board. (The Bill increases the borrowing powers from £300 million to £650 million.) He said the purpose was to make it clear that the period was five years and not 10 years—the period of the Board's investment plan—and to provide an extra opportunity for Parliament to scrutinise the way the money was used. He proposed at the beginning of each financial year to publish a White Paper showing what had happened in the way of investment in all the nationalised fuel and power industries in the year which had elapsed, and also the projected programme for the impending year. He though the Minister of Transport would not be averse to doing something on the same lines. Each White Paper would be a forecast as well as a picture of what had happened.

Mr. Arthur Palmer said that nuclear fission and the power stations associated with it came under the administration of a Minister in the House of Lords and in these circumstances it was doubtful whether the figures in the proposed White Paper would really represent a policy. At present responsibility for the fuel and power industries was extremely loose. If this proposal of an annual scrutiny was a step towards a monetary policy it was a good thing, but he rather suspected that it was a façade to cover the Minister's difficulties with his own backbenchers.

Mr. Gerald Nabarro said that if the Minister did not provide enough detail in his first White Paper there

would be substantial pressure from Conservative members for him to become much more expansive in the material that he laid before the House.

In his reply to the debate, Mr. Aubrey Jones indicated that figures relating to investment in nuclear power would be included in the White Paper. In answer to Mr. Palmer, he said he would see what he could do about including in the White Paper the investment plans of the Atomic Energy Authority affecting electric power. The amendment was carried by 208 votes to 141.

In the debate on the second reading of the Bill, Mr. Dudley Williams said it was unfortunate that it could not have finished earlier so that the debate on the appointment of a Select Committee to examine the reports and accounts of the nationalised industries could have been held, as was planned. He hoped a debate would be arranged very soon on that important subject.

Mr. Palmer said he was interested to note that in the wide-ranging discussions in committee no one had resurrected the argument, used on second reading, that the coal industry would soon be superseded by nuclear energy. The debates would have been useful if they removed from the public mind the idea that the coal industry was a dying industry. It was not. It was an expanding and dynamic industry. It should be appreciated that in 1975, even if the present programme went according to plan, nuclear energy would give the country the equivalent of only 40 million tons of coal a year, which was roughly equal to the present coal consumption of the electricity industry alone. By 1975, in fact, electricity would need 100 million tons of coal.

Mr. Callaghan said that coal would remain the backbone of the nation's fuel and energy for the next 20 years. We needed all the coal and all the miners we could get.

The Bill was given a third reading, and now goes to the House of Lords.

Atomic Energy in Wales

Mr. R. A. Butler, Lord Privy Seal, informed Mr. Gower that the Atomic Energy Authority had in the last few months received a number of suggestions and inquiries about the possibility of siting atomic energy establishments in various parts of Wales. There was, however, at present nothing to add to the information he had already given about the Authority's plans.

Welsh Rural Electrification

In the debate on the Mid-Wales Investigation Report, Mr. Nugent, Parliamentary Secretary, Ministry of Agriculture, said the Government agreed that there was an urgent need for public services in this area. The three services together—roads, electricity and water—cost no less than £4,000 a mile and it was quite evident that it would be impossible ever to take the services to every smallholding in the upland regions. But the Government wanted to go as fast as they could and the results in the last few years had been encouraging. In Wales as a whole 40 per cent of the farms had been connected to electricity mains by April, 1956, compared with 14 per cent in 1948. This was a very satisfactory increase and connections were going ahead at the rate, last year, of 2,500 per annum.

Mr. Roderic Bowen said that difficulties would be eased if the Government allowed the Electricity Board to accelerate its programme of rural electrification. Mr. Cledwyn Hughes said that in rural Wales there were tremendous arrears to be made up in the programme of rural electrification. The Government should allow the amenities to be brought up to the national average.

Technology Qualification

Dr. King asked the Minister of Education whether he would recommend to the Hives Committee that the new qualification in technology should be a degree and not a diploma.

Sir David Eccles replied "No." The power to confer a degree had become the distinguishing mark of a university.

Steel Supplies

In reply to Mr. William Shepherd the President of the Board of Trade (Mr. Thorneycroft) said there were still some difficulties in steel supplies. He was sure that steel producers fully appreciated the needs of export industries and did their best to satisfy their requirements. If there were particular cases of difficulty he would ask the Iron and Steel Board to look into the matter.

Effects of Price Pegging

Mr. Grimond asked the Chancellor of the Exchequer what was the policy of the Government for minimising losses incurred by the nationalised industries in holding down prices.

Sir Edward Boyle, Economic Secretary to the Treasury, replied that so far as the fuel and power group of nationalised idustries was concerned, the Chancellor had no reason to believe that the decision about prices would result in their making revenue deficits.

Mr. Grimond said it was clear that many of these industries already had a deficit which they were carrying forward. If the Government now intended to force them to run up a further deficit, how did they propose to deal with the ultimate result?

Sir Edward Boyle said Mr. Grimond was misinformed about the facts. The Coal Board's announcement about price stabilisation came after an increase in price as from 1st June and the Board had said that in the absence of unforeseen developments this price increase would not merely prevent any growth in its deficit but would reduce it. As for the electricity industry, the Prime Minister had explained that although some Area Boards might be in deficit, the industry as a whole was expected to make a small surplus.

Recent C.E.A. Contracts

Contracts have been placed by the Central Electricity Authority during the past month for power stations, transforming stations and transmission lines amounting in the aggregate to £11,425,152. The principal contracts include the following:—

Marchwood power station, near Southampton. Superstructure: Staverton Builders.

Hayle power station, Cornwall. Main civil works: J. L. Eve Construction Co.

Little Barford "B" power station, near St. Neots. Coal handling plant: International Combustion Prod.

Drakelow "B" power station. One 860,000 lb/hr reheat boiler: International Combustion.

Willington "A" power station. Railway sidings: British Transport Commission.

Spondon power station. Four 180,000 lb/hr stoker fired boilers: Foster Wheeler.

Skelton Grange "B" power station: Condensing plant for three 120,000 kW turbo-generators: G. & L. Weir.

Bold power station. One 60,000 kW turbo-generator: General Electric Co.

Brighton. 132 kV and auxiliary cables: British Insulated Callender's Cables.

Iver substation, Bucks. 275 kV switchgear: A. Reyrolle & Co.

Paignton substation, Devon. Two 30 MVA 132/33 transformers: Johnson & Phillips.

Wigston substation, Leics. Two 30 MVA 132/11 transformers: Crompton Parkinson.

Crewe substation. Modifications to switchgear: Ferguson Pailin.

Stella South and Little Barford substations. 132 kV switchgear: A. Reyrolle & Co.

Round Oak substation. Two 45 MVA 132/33 kV transformers: Ferranti.

Bold "B" substation and Connah's Quay. 132 kV switchgear: Ferguson Pailin.

East Hull substation. Two 45 MVA 132/33 kV transformers: Hackbridge & Hewittic Electric Co.

West Melton substation. 132 kV switchgear: British Thomson-Houston Co.

Penn substation. 275 kV and 132 kV switchgear: General Electric Co.

Cliff Quay, Ipswich. 132 kV cables: Pirelli-General Cable Works.

Tilbury substation. 132 kV switchgear: Metropolitan-Vickers Electrical Co.

Iver-Oxford/Watford. 132 kV overhead line: Balfour Beatty & Co.

Blackburn Meadows-Attercliffe. 132 kV and pilot cables: Pirelli-General Cable Works.

Stella South-Spennymoor, Staythorpe substation-Clipstone substation and Connah's Quay, Oswestry. 132 kV overhead line: British Insulated Callender's Cables.

Connah's Quay, Carrington. 275 kV twin 0.4 sq in overhead line: British Insulated Callender's Cables.

Railway Modernisation

The British Transport Commission's report on "The System of Electrification for British Railways," reference to which was made in our issue of 16th March, has now been published in booklet form. Copies can be obtained from the Commission at 222, Marylebone Road, London, N.W.1, price 3s 6d net.

PERSONAL AND SOCIAL

News of Men and Women in the Industry

Mr. Dennis Watkins has retired from the board of the British Vacuum Cleaner & Engineering Co., Ltd., but will continue in the company's service and has been appointed personal assistant to the managing directors (works and branch factory liaison). A presentation of an escritoire cabinet was made to him in the works canteen at Goblin Works, Leatherhead on 27th June. Mr. Watkins joined the company in 1911 and has now completed 45 years' service.

The Siemens-Ediswan Organisation announce the appointment of **Mr. R. B. Greenwood** as publicity manager. Mr. Greenwood will be responsible for the advertising and publicity of the two companies within the organisation. Joining Siemens Electric Lamps & Supplies, Ltd., as publicity manager in 1953 he was additionally appointed sales promotion manager of that company. In 1954 Mr. Greenwood became publicity manager of the Siemens Brothers group of companies, retaining the position of sales promotion manager for the lamp company.

Mr. R. B. Greenwood

Riley (IC) Products, Ltd., a subsidiary of International Combustion (Holdings), Ltd., announce the following appointments resulting from the death of the chairman, Mr. Vernon Young, F.C.I.S.:—**Mr. W. Messer,** D.I.C., A.M.I.CE., A.M.I.E.E., until now managing director, becomes chairman, **Mr. E. W. Barnes** M.Inst.F. (director), becomes managing director, and **Mr. J. W. Wray,** M.Inst.F., a director of International Combustion Products, Ltd., now becomes a director of Riley (IC) Products, Ltd. The other directors of the company are **Mr. W. Grainger,** M.Inst.F., and **Mr. H. C. Short,** F.A.C.C.A. **Mr. A. C. Syrett,** A.M.I.Mech.E., has been appointed general sales manager.

Mr. P. Calvert, Associate I.E.E., has been appointed London branch manager for Long & Crawford, Ltd., Manchester. Mr. Calvert was an apprentice draughtsman with A. Reyrolle & Co., Ltd., Hebburn-on-Tyne, and afterwards served in the Switchgear Design and Contracts Departments. For the last seven years, he has been attached to the London office of George Ellison, Ltd., as technical sales engineer. The address of Long & Crawford's London office will be announced shortly. In the meantime, Mr. Calvert will operate from his home at 4, Kendor Avenue, Epsom, Surrey (telephone: Epsom 9443).

The Ministry of Supply announces that **Mr. E. W. Chivers** has been appointed principal superintendent of the Electronics Division of the Armament Research and Development Establishment at Fort Halstead, Sevenoaks, Kent. Mr. Chivers will take up his new appointment in September next.

Mr. G. S. Hibbs, sales manager of Alfred Imhof, Ltd., has been appointed sales director of the company.

The Northern Aluminium Co., Ltd., announces that **Mr. A. K. Jordan,** assistant general sales manager, has left the company to take up the post of general sales manager with the Aluminium Co. of Canada, Ltd. (Alcan). Mr. Jordan was Alcan's export sales manager before joining the Northern Aluminium Co. in 1951. Apart from wartime service with the Canadian Army, which he left with the rank of Lt.-Colonel, he has been with the Aluminium, Ltd., group for twenty-six years. He is succeeded by **Mr. J. H. Mayes,** who joined the Technical Department of the company in 1934. Since 1946, Mr. Mayes has successively been responsible for sales development, castings and forgings sales and, latterly, export sales departments.

Mrs. Margaret Pybus has been appointed demonstrator for the Jackson Electric Stove Co., Ltd., in the Midlands and East Midlands Electricity Board areas. Until recently she has been a demonstrator for the company in the Eastern and London Board areas.

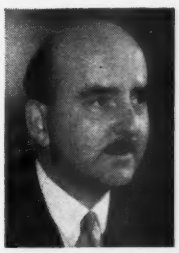
Mr. E. J. Clarke, chief engineer of Murex Welding Processes, Ltd., Waltham Cross, Herts, has retired after thirty-eight years' service with the company and to mark the occasion Mr. J. M. Willey, director and general manager of the company, presented him with a fitted wardrobe on behalf of Murex employees.

Mr. E. J. Clarke

Mr. Clarke commenced with Alloy Welding Processes, Ltd., in 1918 and this company later became Murex Welding Processes, Ltd. Mr. Clarke was prominent in the development and production of many new welding electrodes, including extruded welding electrodes and he made one of the earliest forms of extruders. He was also active in developing new machinery for the mass production of electrodes. Mr. Clarke has taken a leading part in local industrial affairs.

Mr. H. W. H. Icough, who has been responsible for the Wirework and Wire Weaving Departments of G. A. Harvey & Co. (London), Ltd., for many years, has retired after fifty years' service with the company. On 29th June the managers and staff presented him with a gift. Mr. Blakeley, works director, expressed appreciation of the long and valuable service rendered by Mr. Icough to the company, and the presentation was made by Mr. Garland. Mr. Icough was chairman from 1942 until his retirement this year of the Woven Wire Manufacturers' Association.

Mr. R. E. Burnett, M.A. (Oxon), A.M.I.E.E., has been appointed general manager of Marconi Instruments, Ltd., in succession to **Mr. J. M. Furnival,** M.B.E., who retired from that position on 30th June but remains with the company in a consultative capacity.



Mr. R. E. Burnett

After service as a Wing Commander during the 1939-45 war, Mr. Burnett worked for some years in the Ministry of Labour and National Service in connection with the Scientific Register and with the technical aid programme for underdeveloped territories. He joined Marconi's Wireless Telegraph Co., Ltd., in 1950 as manager of education and technical personnel and principal of Marconi College. Subsequently he was appointed assistant to the general manager and, in November last, deputy manager.

Mr. Tom Wilson, aged sixty-nine, has retired after fifty years' service with W. T. Glover & Co., Ltd., Trafford Park, Manchester. At a presentation ceremony recently, held at the works, Mr. Wilson received a cheque subscribed to by employees and from the directors he received a radiogram. He joined Glovers in 1900, stayed a short while and after serving his apprenticeship elsewhere returned in 1906. He retired as foreman joiner,

in which capacity he served for many years.

Mr. Aubrey Jones, Minister of Fuel and Power, is to visit Russia next month to study fuel and power organisation, in response to an invitation from Mr. Malenkov. He will leave London for Moscow on 12th August and will return on 28th August.

The Northern Ireland Minister of Commerce has appointed **Professor K. G. Emeleus,** Professor of Physics at Queen's University, Belfast, to be his hon. adviser on nuclear physics.

Mr. Philip Rose has been appointed sales manager of Ward & Goldstone, Ltd., and its home associated electrical companies. He joined the company in 1935 and has been attached to the sales organisation since then, apart from war service with the Royal Air Force.

Mr. P. Rose

The South Eastern Area final of the **Electrical Industries National Golf Championship** was held on 29th June at Addington Golf Club and, although rain and drizzle made conditions a little difficult, the various reports received during the dinner which followed at Addington Clubhouse indicated that the day was enjoyed by all participants. The results were as follows:—Area final: Winner, Mr. R. E. Prickett; runner-up, Mr. H. Dupin; best scratch, Mr. F. Cooley. Open competition: Winner, Mr. A. G. Richards; runner-up, Mr. F. Holland; best scratch, Mr. F. Cooley. Visitors' competition: Winner, Mr. W. G. Pierce. This year the runner-up in the open competition received a trophy which had been presented by Johnson & Phillips, Ltd., and is to be known as the "J. & P." Trophy. A sum of over £200 was raised for the Electrical Industries Benevolent Association.

The twelfth annual sports meeting of the **Telegraph Construction & Maintenance Co., Ltd.,** and its associate company, **Submarine Cables, Ltd.,** was held on 30th June at the Kidbrooke Sports Ground of the Telcon Social and Athletic Club. The factories at Greenwich, Crawley, Farnborough (Kent) and Erith (submarine cables) were well represented and the Sir Geoffrey Clarke departmental challenge cup was won by the General Office. The prizes were presented by Mr. J. N. Dean, chairman of Telcon.

Over a thousand employees of **Oldham & Son, Ltd.,** spent last Saturday at Blackpool on their annual outing. This was the ninth time that the whole firm had been entertained by the directors to a day at the seaside. Every member of the party was presented by the directors with a £1 note as well as with tickets entitling them to take part in many of Blackpool's amusements and entertainments. All the directors were present, including Mr. John Oldham, O.B.E., chairman, and Mr. Edward Oldham.

The annual gala and sports day of **Hoover, Ltd.,** was held at the company's sports ground at North Wembley, Middlesex, on 23rd June, in the presence of Mr. S. Roberts, managing director, and Mrs. Roberts, who presented the prizes. The directors' challenge cup cricket competition was won for the second year in succession by the northern division of the sales-service organisation in a final played against the staff of the Perivale, Middlesex, factory. Apart from a full programme of athletic events, there was a horticultural exhibition, dancing, and a fireworks display.

The annual sports gala of **Johnson & Phillips, Ltd.,** was held at the company's Sports Club ground at Kidbrooke on 23rd June. The weather was kind, the attendance good and several ground records were broken. Several well-known athletic clubs competed. The company's inter-departmental shield was won for the fifth year in succession by the Switchgear Department which defeated the Maintenance Department by the narrow margin of three points. The prizes were presented at the end of the day by Mrs. Whitehead, the wife of Mr. G. T. W. Whitehead, O.B.E., works director.

Mr. Stanley R. Rogers has been appointed assistant foundry sales manager for Carron Company, Carron, Falkirk. He joined the company as an office boy in its showrooms at 22-26, Redcross Street, Liverpool. In 1950 he was appointed the company's midlands area representative. His new appointment became operative on 1st July last.

Mr. S. R. Rogers

The Worshipful Company of Tinplate Workers announces the award of travelling scholarships for 1956 (value £50) to the following:—

R. H. Linsdell, employed by the Metropolitan-Vickers Electrical Co., Ltd., presented by the B.E.A.M.A., and sent to I.C.I. (Metals), Ltd., Witton, Birmingham; R. Linaker, employed by Metropolitan-Vickers, presented by the B.E.A.M.A., sent to Yarrow & Co., Ltd., Scotstoun, Glasgow; S. D. Ferguson, employed by the Merseyside & North Wales Electricity Board and sent to W. T. Henley's Telegraph Works Co., Ltd.; L. M. Davies, employed by the Steel Company of Wales, Ltd., presented by the W.S. & P.M.A., and sent to the Yorkshire Copper Works, Ltd.; P. E. Harris, employed by International Combustion, Ltd., presented by the W.T.B.M.A., and sent to Dorman, Long & Co.; B. Rudd, employed by John Thompson, Ltd., presented by the W.T.B.M.A., and sent to British Insulated Callender's Cables, Ltd.; P. B. Spencer, employed by I.C.I. (Metals), Ltd., presented by the H.C.A., and sent to Metropolitan-Vickers; M. J. Bland, employed by the Mint, Birmingham, presented by the B. & C.T.A., and sent to British Railways, Swindon; P. B. Spencer, employed by Yorkshire Copper Works, Leeds, presented by the B. & C.T.A., and sent to South Wales Steelworks; W. Y. Milton, employed by James Scott & Co., Ltd., presented by the E.T.U., and sent to Enfield Cables, Ltd.; B. Plummer, employed by W. T. Henley's Telegraph Works Co., presented by the C.M.A., and sent to the South Wales Steelworks; and Kenneth Sheaf, employed by Henley's, presented by the C.M.A., and sent to Yarrow & Co., Ltd.

Threatened thunderstorms held off at the annual championship sports and gala of the **General Electric Co., Ltd.,** at the company's sports ground, Wembley, last Saturday and a programme of 36 events was efficiently and expeditiously carried through. Head Office secured the "Leslie Gamage" trophy for the leading London establishment, with 34 points, the runners-up being the Union Works (29 points). At the close of the afternoon the prizes were presented to the winners by the Hon Mrs. Leslie Gamage.

Associated Electrical Industries, Ltd., states that **Mr. C. Y. Knight,** who is leaving Australia to live in England at the end of this year, has announced his intention to retire from the A.E.I. companies. He will cease to be chairman and a director of Australian Electrical Industries Pty., Ltd., as from the 7th September next, but will remain as deputy chairman of A.E.I., Ltd., until his departure from Australia towards the end of the year. **Major General Sir Jack Stevens,** K.B.E., C.B., D.S.O., E.D., joins the board of the A.E.I. group in Australia on 7th September, following his retirement from the Commonwealth Public Service and the chairmanship of the Australian Atomic Energy Commission. He will succeed Viscount Chandos, D.S.O., M.C., P.C., as chairman of the holdings company, A.E.I., Ltd. and Mr. Knight as chairman and chief executive of the operating company, Australian Electrical Industries Pty., Ltd.

Mr. M. Molen, formerly with Cossor Instruments, Ltd., for fourteen years, has now joined the staff of E.A.P. (Tape Recorders), Ltd., as general manager.

On 4th July, Mr. C. H. Blackburn (vice president) and Mr. A. B. Wildsmith (director and secretary) of the **Electrical Wholesalers Federation,** visited Belfast for the inaugural meeting of the Northern Ireland Section. Mr. V. Leonard (V. Leonard & Co.) was elected chairman of the Section

and Mr. G. W. Hamilton (Dunlop & Hamilton, Ltd.), hon. secretary. The Section recommended to the Council that Mr. L. Scop (Eirco Wholesale, Ltd.) be co-opted as section councillor for the rest of the Federation year.

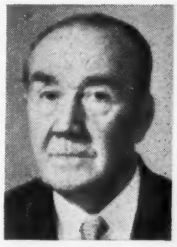
OBITUARY

Mr. E. A. Richards, M.B.E., B.Sc., A.C.G.I., M.I.E.E., formerly chief rectifier engineer, Standard Telephones and Cables, Ltd., died at his home at Bexhill-on-Sea, on 20th June, aged seventy-one. Educated at Norwood High School, South Western Polytechnic, and City and Guilds College, Mr. Richards gained a science degree and joined the Telephone Engineering Department of Siemens Brothers & Co., Ltd. His service with that company was interrupted by duty with the R.F.C., later the R.A.F., from 1915 to 1919, and, resuming his civil occupation, he was ultimately in charge of the Telephone Equipment and Sales Engineering Department. In 1929 he joined the European Commercial Department of the International Standard Electric Corporation was transferred in 1931 to Standard Telephones and Cables, Ltd., and from 1934 until 1936 was chief engineer of Broadcast Relay Services. Returning to Standard Telephones and Cables, Ltd., in 1936, he took charge of the sales, engineering and development groups of the rectifier division, pioneering in the United Kingdom the selenium metal rectifier. Mr. Richards was awarded the Siemens Memorial Medal in 1913; Students' Premium I.E.E. 1914, for his paper "Single-phase Commutator Motors"; and Extra Premium I.E.E. in 1941 for his paper on "Characteristics and Application of Selenium Rectifiers." He was awarded the M.B.E. in 1946 for his work in increasing the production of selenium rectifiers during the war. He retired from Standard Telephones and Cables in 1954.

Mr. Robert Wilfred Lucas Phillips, for thirty-seven years borough electrical engineer of Bedford, has died at the age of eighty-three; he retired in 1938. Mr. Phillips was apprenticed at Taunton and in 1894 joined the Bristol Corporation Electricity Department where he became deputy city electrical engineer in 1901. In that year he was appointed borough electrical engineer at Bedford and in 1930 he dealt with the electrification of about 100 square miles of the rural part of the county. He became a member of the Council of the I.M.E.A. and was president five years later. Among other offices held by him, he was a member of the National Consultative Committee of the Central Electricity Board and he represented the Board on the E.D.A. Council.

Mr. G. W. Clarkson.—The death occurred on 25th June of Mr. George W. Clarkson, A.M.I.E.E., M.Inst.F., chief generation engineer (operation) of the South Western Division of the Central Electricity Authority. Mr. Clarkson was born in 1897 and was educated at Leeds University and Dewsbury Technical College. He received his practical training with the Yorkshire Electric Power Co., with whom he became assistant engineer in 1922. In 1926 he joined I.C.I., Ltd., at Billingham, as design and construction engineer, later becoming operation and maintenance engineer. In 1931 he went to Worcester as chief assistant engineer and was appointed city electrical engineer and manager at Worcester in 1940, a position he held until nationalisation when he was appointed to the C.E.A. South Western Division. Mr. Clarkson was chairman of the Central England Area of E.D.A. in 1946-47, and had served on the Council of the Incorporated Municipal Electrical Association.

Mr. F. J. Cowlin.—The death occurred suddenly on 28th June in Klagenfurt, Austria, at the age of sixty-five of Mr. F. J. Cowlin, O.B.E., M.I.Mech.E., A.M.I.Mar.E., chief engineer, steam turbine division, English Electric Co., Ltd. Mr. Cowlin had been attending the World Power Conference in Vienna. He received his technical education at East London College, under the late Professor D. A. Low, and the Royal Technical College, Glasgow. His early practical training was obtained as a pupil of the late Sir Alfred Yarrow in London and Glasgow. In 1911 he joined the drawing office of Willans and Robinson, Rugby, and was from the outset associated with the development of steam turbine plant. During the 1914-18 war he served in the Royal Engineers, gaining a commission and, on demobilisation, he returned to his old company at about the time of its absorption into the English Electric organisation. He was appointed assistant chief draughtsman, primarily in charge of the steam turbine section, and during the next 15 years took an outstanding part, in collaboration with the Chief Designer (the late Mr. J. P. Chittenden) in steam turbine developments. This period saw the inception of the early two and three cylinder designs, including the first 30 MW 3,000 r.p.m. unit to be produced in this country. In 1937 he was appointed deputy chief engineer, Steam Turbine Designs Department, and he became chief engineer in 1943, when Mr. Chittenden retired. Mr. Cowlin pioneered many notable developments, from the new 30 MW and 60 MW designs to suit the C.E.A. standard conditions, and high pressure and temperature 60 MW units, to the latest 200 MW turbines operating at 2,350 lbs/sq in.



The late Mr. F. J. Cowlin

He was also responsible for designs of propulsion turbines for naval vessels and was awarded the O.B.E. in the last New Year Honours for this valuable contribution.

Mr. L. D. Schofield, area representative for Holophane, Ltd., in Yorkshire, died on 3rd July at the age of sixty-two. He joined Holophane in 1930.

Provost Robert Hunter of Musselburgh, collapsed and died at his home on 30th June, aged 67. He was a member of the South of Scotland Electricity Board and had served as a member of the Joint Industrial Council. He was for many years chief maintenance engineer with the Musselburgh and Fisherrow Co-operative Society.

Mr. Cyril Mancha Bennett, former chief control engineer to the London Power Co., Ltd., died on 5th July at the age of eighty-one. Mr. Bennett, who retired in 1945, was appointed chief control engineer of the London Power Co. in 1926 when the Wood Lane works of the Kensington and Knightsbridge and Notting Hill Electric Lighting Companies, of which he was chief engineer, were closed down. For many years he represented the London Electricity Supply Association on the Council of the E.R.A.

Mr. J. Entwistle.—The death occurred on 4th July at the age of sixty-three of Mr. Joseph Entwistle, A.M.I.E.E., who was sales director of Mersey Cable Works, Ltd., until ill health called for a reduction in his commitments in 1955; he was also a director of H. J. Baldwin & Co., Ltd.

After serving with the Lancashire Fusiliers and Royal Warwickshire Regiment in the 1914-18 war, Mr. Entwistle obtained his early training and professional experience with the Western Electric Co., Ltd. (now Standard Telephones & Cables, Ltd.). He was elected to the board of H. J. Baldwin & Co., Ltd., in 1936, and in 1937, whilst remaining a director, he joined the Simplex Electric Co., Ltd., with whom he remained until August, 1939. A major, Royal Engineers, in the Territorial Army, he was recalled for active service, but after a serious illness in June, 1940, Mr. Entwistle was invalided from the Army and joined Mersey Cable Works, Ltd., becoming a director in 1942. He was a past president of the Birmingham Electric Club and he was also a member of the Association of Mining Electrical & Mechanical Engineers; he had also served on the Committee of the E.I.B.A. (West Lancs, Merseyside and North Wales Area).

Wills

Mr. W. J. Oswald, A.M.I.E.E., a member of the South Eastern Electricity Board, former president of the Electrical Power Engineers' Association, who died on 9th March last, left £6,274 gross (£6,200 net).

Mr. S. R. Siviour, O.B.E., M.I.E.E., formerly chief engineer to the Yorkshire Electricity Board, and previously deputy general manager of the Yorkshire Electric Power Co. and its associated concerns, who died on 12th March last, left £6,786 gross (£6,720 net).

Financial Section

REPORTS AND DIVIDENDS

Ferranti, Ltd.—In his statement which has been circulated with the report and accounts for the year to 31st March last, Sir Vincent de Ferranti (chairman and managing director) says that although the outputs of most departments show increases over the previous year, an extensive programme of research and development is vital to ensure that such increases will be maintained, and, during the past year, a significant proportion of the company's resources has been absorbed in such a programme.

Further research and development in the field of electronic digital computers has been pursued; the "Pegasus" and "Mercury" computers have been well received, and additional production facilities have been planned to come into operation during the next financial year. Collaboration with Powers-Samas Accounting Machines, Ltd., both in development and marketing of commercial data-processing equipment is proceeding satisfactorily. Research and development work is also being carried out in semi-conductor diodes and the corresponding triodes, or transistors, and the range of silicon diodes which went into production last year has already been extended. Other new developments are the computer-controlled machine tool and aircraft fire-control systems for high-speed aircraft. Quantities of guided missiles are being produced for trials purposes, and a new laboratory has been opened at Bracknell in Berkshire, to undertake the development of navigational instruments.

The sales input of power transformers has reached a record figure. and includes the supply of twenty-one 63MVA transformers for the Dalles Dam Project in the United States and nine 60MVA transformers for New South Wales. Among high-voltage testing equipments completed or nearing completion, a 4,000,000 V 287 kW-second capacity impulse generator commissioned in their own factory is believed to be the highest in voltage and largest in capacity in Europe. The level of activity in the field of distribution transformers has been considerably increased by the new developments in lock-wound cores for rural units, dry-type fire-resistant transformers, and Pyroclor-filling. Both output and sales input of electricity meters show a marked increase compared with the previous year. Although the total figures for sales of radio and television receivers and of radiant electric fires show an increase, these received a check towards the latter part of the year from the measures taken by the Chancellor of the Exchequer to restrict domestic spending. The increased manufacturing facilities for cathode-ray tubes are now in operation and the output has risen by 50 per cent. The output of instruments has again slightly increased and the production of the Scottish factories also increased during the year. About 40 per cent of the output has been exported, much of it going to hard currency areas. In Canada the output has remained approximately as in the previous year. Ferranti Electric, Ltd., has made a major addition to the factory at Toronto, which permits the maximum weight of transformer manufactured to be increased to 240 tons. The meter division has brought its new thermal demand meter into production, as a first step in expanding its range of meters.

The Electric Construction Co., Ltd.—The main figures in the accounts for the year ended 31st March last were given in our last issue. In his statement which has been issued with the report and accounts, Mr. C. Reid (chairman) says that the lower trading surplus is mainly due to the rising costs of materials and increased wages resulting in smaller profit margins on many of the products. Quicker deliveries during the year have resulted in increased orders and to-day the order book is larger than it has ever been in the history of the company. The subsidiary, Tyseley Foundry, has had a satisfactory year. The South African factory is now working to capacity and it is hoped will make its contribution to the group's profits during the course of the next year. The Canadian market is still a difficult one; they will, however, pursue and develop this market, but without capital commitment. Valuable orders have been received from Australia.

They have developed special equipment which is being supplied to the telecommunications industry, and they have introduced an entirely new range of automatic control gear. This is designed for easy assembly, both in this country and abroad.

Vent-Axia, Ltd.—In his statement which accompanies the report and accounts for the year to 31st March last, Mr. J. C. Akester (chairman) says that sales of Vent-Axia units have again increased throughout the year and the upward trend has continued during the first quarter of the present financial year. Exports have also improved and should continue to do so. The subsidiary, Axia Fans, Ltd., has made a substantial contribution to the improved results.

George Cohen, Sons & Co., Ltd.—The group profits for the year ended 31st March last amount to £1,856,808, as compared with £1,417,417 for the preceding year, and after providing £966,817 for taxation, the net balance is £889,991 (against £646,160). It is proposed to pay a final ordinary dividend of 7½ per cent, making 11 per cent for the year. For the previous year the total distribution was 15 per cent on smaller capital.

To simplify the group's administration and control it is proposed to change the name of the parent company to George Cohen 600 Group, Ltd. (or such similar name as may be approved by the Board of Trade), and to form a new subsidiary company to take over the trading activities of the parent company which will adopt the name of the parent company, and the renamed parent company will then become solely a holding company.

Permali, Ltd., is paying a final dividend of 8 per cent, making 13½ per cent for the year on capital increased from £300,000 to £400,000. For 1954-55 a total of 12½ per cent was paid on smaller capital. Group profits were £70,605 (£70,948), after providing £34,229 (£25,452) for depreciation and £67,226 (£54,482) for tax.

The Telephone & General Trust, Ltd., announces a one-for-five rights issue at 35s per share to raise £428,000. The issue of 245,000 £1 ordinary shares will be made to ordinary and "A" ordinary stockholders registered on 30th June. The new shares will not participate in any interim dividend for 1956.

McMichael Radio, Ltd.—S. G. Warburg & Co. state that the offer made on behalf of Radio and Allied Industries to acquire the issued share capital of McMichael Radio has been accepted by the holders of more than 90 per cent of each class of share.

The Uganda Electricity Board.—Particulars have been announced of an issue of £EA.6,000,000 5 per cent guaranteed stock, 1972-78. The stock is being issued at £EA.98 per cent, payments being spread over four months. Of the total, £EA.3,650,000 has already been placed, leaving the balance of £EA.2,350,000 for subscription. The proceeds of the issue will be applied to replacing monies borrowed temporarily to meet capital expenditure. It is stated that the installed capacity of the Owen Falls hydro-electric power station is planned for 150 MW and it is estimated that present known commitments, including a bulk supply to the Kenya Power Co., Ltd., will absorb the total output by 1965.

Lightfoot Refrigeration, Ltd., is reducing its dividend for 1955 to 2½ per cent from the 6 per cent paid in 1954. Group trading profits fell from £60,396 to £35,083 and the net profit was £10,649 (£23,938) after providing £5,503 (£20,528) for tax.

Johnson, Matthey & Co., Ltd.—After tax provision of £1,004,463 (£844,550) the net profit for the year

to 31st March, last, was £1,032,747 (against £887,524). A final dividend of 6 per cent is again being paid, making the total for the year 9 per cent (same). Meeting, 25th July.

The Revo Electric Co., Ltd.—In his review of the past year's activities of the company, Mr. W. L. Barrows (chairman) says that the domestic appliances side of the business has been adversely affected by the hire and hire-purchase restrictions. The company is, fortunately, not solely dependent upon domestic appliances, as it is a leading supplier of street lighting equipment, fans, etc. All possible steps to increase export business have been taken and have achieved considerable success. A substantial contract has been received in connection with work for the United Kingdom Atomic Energy Authority. The volume of orders is impressive, yet the difficulty of increasing prices to meet the rapidly rising costs makes the outlook difficult to assess.

Berry's Electric Magicoal, Ltd.—The consolidated net profit for the period from incorporation on 24th February last to 31st March, and of the subsidiary for the year to 31st March last, is £144,628, before deducting taxation of £69,524. The company was incorporated to acquire the issued capital of Berry's Electric, Ltd., the operating company, and, as stated at the time, no final dividend for the year is recommended. The directors in February forecast a 10 per cent dividend for the current financial year, including an interim dividend in November.

Hick, Hargreaves & Co., Ltd.—After providing £284,129 for taxation, the net profit for the year to 31st March last is £289,579, as compared with £254,468 for 1954-55. General reserve receives £170,000 and it is proposed to pay a final dividend of 10 per cent and a bonus of 3½ per cent, on capital increased by a one-for-two scrip issue. An interim dividend of 5 per cent was paid before the scrip issue. For the previous year the total distribution on the old capital was 25 per cent.

Marryat & Scott, Ltd.—The group profit for the year ended 31st March last is £141,310, as compared with £148,313 for the preceding year, and after deducting £71,914 for taxation, the net profit is £69,396 (against £76,078). The ordinary dividend for the year is maintained at 30 per cent and £185,471 is carried forward (against £140,275 brought in).

New Companies

W. H. Tyler (Electrical), Ltd. Registered 16th May. Capital £2,000. Electrical engineers, etc. Directors: W. H. Tyler and Mrs. Joan V. B. Tyler. Regd. office: 48, Bushloe End, Wigston Magna.

Contronics, Ltd.—Registered 17th May. Capital £1,000. Electronic and automation engineers, etc. Directors: C. N. Stuart and Jean A. Stuart. Regd. office: Deepcut Bridge Road, Blackdown, Hants.

Precision Miniwindings, Ltd.—Registered 16th May. Capital £100. Manufacturers of and dealers in electronic components of all kinds, including dynamos, armatures, motors, electric fans, blowers, magnetos, etc. Regd. office: 152, Fenchurch Street, E.C.3.

Burrows and Son, Ltd.—Registered 16th May. Capital £2,000. Manufacturers of and dealers in general electrical goods, etc. Directors: Mrs. Margaret Burrows and S. Melling. Regd. office: 62, Darlington Street, Wigan.

Medelec, Ltd.—Registered 16th May. Capital £100. Electrical, electronic, radio, research, experimental, mechanical and general engineers, etc. Directors: A. L. Craven, Vera G. Craven, P. R. D. Styles and Eileen M. Styles. Regd. office: Cambridge House, Commercial Road, Woking, Surrey.

McKellen Automation, Ltd.—Registered 22nd May. Capital £7,000. To acquire such plant, fixtures, furniture, stock and other assets from F. C. Robinson and Partners, Ltd., as may be agreed upon and to carry on the business of manufacturers of and dealers in electrical and electronic instruments, devices or apparatus to be used in industry and in the automation of manufacturing and other processes, etc. Directors: F. P. McKellen, Ina J. McKellen and G. M. P. McKellen. Regd. office: 20, Booth Street, Manchester, 2.

Elcotron (London), Ltd.—Registered 4th June. Capital £4,100. Mechanical and electrical engineers, founders, smiths, etc. Solicitors: Bartlett & Gluckstein, 199, Piccadilly, W.1.

Electromedica Co., Ltd.—Registered 4th June. Capital £100. Manufacturers of and dealers in electrical, electronic, electromedical, surgical, scientific, radio and mechanical goods of all kinds, sun lamps, arc-lamps, etc. Directors: W. E. E. Hare and Mary T. A. Hare. Regd. office: Jacey House, Lansdowne, Bournemouth.

Bray Fennell & Co., Ltd.—Registered 12th June. Capital £1,000. Electrical and electronic contractors, etc. Directors: W. E. Bray and L. J. Fennell. Regd. office: 152a, High Street, Harlesden, N.W.10.

Burns Bright Lamps, Ltd.—Registered 12th June. Capital £1,000. Manufacturers of and dealers in electric lamps of all kinds, etc. Directors: A. P. Burns and Mrs. Bella Burns. Regd. office: 17, Russell Street, Leeds.

Miniponents, Ltd.—Registered 13th June. Capital £1,000. Manufacturers of and dealers in and repairers and letters on hire of electrical and mechanical measuring, testing, controlling, physical and scientific apparatus, etc. Regd. office: Lower Mortlake Road, Richmond, Surrey.

Bankruptcies

A. J. Sweeny, 86, Albert Road, South Norwood, London, S.E.25, electrical contractor. —Public examination 18th October at the County Court, Scarbrook Road, Croydon, Surrey.

A. Ferguson, A. Ferguson, jun., and **J. Siddon,** formerly carrying on business in partnership as A. Ferguson & Son, radio and television retailers, at 259, North Wingfield Road, Grassmoor, Chesterfield, and at 39, Beetwell Street, Chesterfield.—First meeting held 3rd July at the Official Receiver's Office, 55, Queen Street, Sheffield. Public examination 21st September at the Court House, Brimington Road, Chesterfield.

H. Pryor, carrying on business as W. Pryor, electronic engineer, at 36, Low Hill, Liverpool, 6.—Trustee, Mr. S. O. Henry, 5, Rumford Place, Liverpool, 3, released 4th June.

H. J. Gornall, electrical engineer, carrying on business at 12, Fish Street, Shrewsbury, Salop.—Trustee, Mr. F. C. Ormrod, 12, Lonsdale Street, Stoke-on-Trent, Official Receiver, released 22nd June.

C. A. Smith, lately carrying on business at 4, Gothic Arcade, Snow Hill, Birmingham, under the style of "Birmingham Electrical Company," electrical contractor.—First and final dividend of 2d in the £ payable at the Official Receiver's Office, Somerset House, 37, Temple Street, Birmingham, 2.

D. E. Pitchers, formerly trading at 13, Tann Lane, Caister-on-Sea, Norfolk, radio and electrical engineer.—First and final dividend of 1s 11½d in the £ payable at the Official Receiver's Office, Castle Chambers, Opie Street, Norwich.

A. S. F. Cracknell, lately residing and carrying on business at 253, Mersea Road, Colchester, as an electrical engineer, under the title of Helier Electric (Colchester).—Trustee, Mr. R. A. Paterson, Archdeacon House, Northgate Street, Ipswich, appointed 29th June.

CATALOGUES AND LISTS

AIRCRAFT ACTUATORS.—Four publications covering seven types of rotary and linear actuators for operation from a 28 V d.c. supply.—**English Electric Co., Ltd.,** Aircraft Equipment Division, Bradford.

CLUTCHES.—12-page descriptive booklet dealing with the Igranic-Stromag electromagnetic multi-disc clutches.—**Igranic Electric Co., Ltd.,** Bedford.

ELECTRICAL EQUIPMENT.—160-page illustrated and priced general catalogue covering equipment supplied by the company, including cables and conduits, lighting fittings, wiring accessories and domestic appliances.—**Farmer, Stedall & Co., Ltd.,** 145-157, St. John Street, Clerkenwell, London, E.C.1.

FURNACES.—Descriptive brochure (130/2) giving particulars of the company's mains frequency coreless induction melting furnace.—**Birlec, Ltd.,** Tyburn Road, Erdington, Birmingham, 24.

INSTRUMENTS.—Leaflet (108A) describing decade resistance boxes and Wheatstone bridges.—**Doran Instrument Co., Ltd.,** Stroud, Glos.

Descriptive catalogue (IN.17V) of the 7-range clip-on volt-ammeter, types V and HFV, the latter being designed for use on the 400 c/s supply found in modern aircraft. —**Ferranti, Ltd.,** Hollinwood, Lancs.

INSULATING MATERIALS.—28-page handbook giving basic technical details of the company's products, in particular mica, micanite and "Lamalac" (synthetic resin laminates).—**Mica and Micanite Supplies, Ltd.,** Barnsbury Square, London, N.1.

LIGHTING FITTINGS.—Illustrated 36-page catalogue describing lighting fittings in the company's range including hand-made fittings in wrought-iron and brass.—**Stephen Glover & Co.,** Intown, Walsall.

Folder containing leaflets and price list of "Berleon" fluorescent fittings and accessories.—**H. Strong & Son, Ltd.,** 20-21, Church Lane, Willesden, London, N.W.10.

Fifty-one page catalogue (804) illustrated partly in colour and describing the company's range of contemporary style lighting fittings. —**Falk, Stadelmann & Co., Ltd.,** 91, Farringdon Road, London, E.C.1.

Leaflet (P.5601) giving particulars of the "Reflectortight" non-corrodible watertight fittings.—**Rowlands Electrical Accessories, Ltd.,** R.E.A.L. Works, Hockley Hill, Birmingham, 18.

MOTORS.—7-page catalogue (PS/127) dealing with the "600 Series" direct current mill motors.—**English Electric Co., Ltd.,** Stafford.

SWITCHGEAR.—Loose-leaf catalogue describing high and medium voltage switchgear of various types.—**Yorkshire Switchgear & Engineering Co., Ltd.,** Meanwood, Leeds, 6.

TRANSFORMERS.—Price list of "Variac" voltage-regulating transformers, "B.A.T." booster transformers, a.c. automatic voltage stabilisers and industrial regulators.—**Claude Lyons, Ltd.,** 4-10, Ware Road, Hoddesdon, Herts.

STOCKS and SHARES

INDUSTRIAL markets of the Stock Exchange have been unable to make headway against anxieties connected in particular with the labour problems of the motor and steel industries, and with the more general field of wages and prices. After a further recession, however, and with encouragement from the Chancellor's latest economic review, prices began to regain steadiness. Business has become very quiet except in such pockets of activity as the oil market. Confidence was helped by a better tone in the gilt-edged market following the announcement of the Treasury's plans for dealing with an £824 million re-financing problem.

G.E.C.

A final dividend declaration, together with the preliminary statement of results for the year ended in March, is expected from the General Electric Company on Tuesday, 24th July. A year ago the company reported an expansion by practically a half in the net profit, and raised the ordinary distribution from 12½ to a total of 14 per cent. There were references then in the annual report to some deterioration in conditions affecting certain of the consumer goods produced by the group, owing to Government measures to curtail domestic expenditure, and this is one of the considerations taken into account by the market in moderating its dividend expectations. On the last rate, the yield on the shares at 53s 9d is 5¼ per cent. The interim dividend was repeated at 4½ per cent.

Price Changes

The list of electrical share prices again shows widespread losses of a shilling or so, but it can be recorded that in a good many cases there has been a partial recovery from larger falls. Shares associated with the motor industry remained generally depressed, although Lucas resisted any further decline. While a few more quotations have joined those standing at the lowest of the year, the leaders of the electrical equipment market are mostly still clear of that mark. British Aluminium have continued to provide a cheerful exception to the trend in rising to the new height of 65s 9d. Marryat & Scotts at 11s 3d and Holophanes at 19s 9d, share the distinction of standing at the year's best prices. The former company announces the maintenance of this year's dividend at 30 per cent.

Power Securities Issue

New £1 ordinary shares offered to shareholders of Power Securities Corporation at 28s are available in the market at around 38s 6d and will be transferable free of stamp until the early part of next month. At this price there is a prospective yield of a little under 5¼ per cent on the shares, assuming the maintenance of the dividend at this year's rate of 10 per cent on the ordinary capital as increased by the issue to £1¼ million. The new money is being raised to finance expanding business, particularly in connection with export contracts. A steady expansion of earnings has enabled the company to raise the dividend by 1 per cent on each of the last four occasions without departing from a strictly conservative distribution policy. Through Balfour

Price Changes in

Company or Board	Nom. Value	Middle price 9th July	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Gilt-edged Stocks								
Brit. Elec. 1968/73	100	74½		3	3	4 0 6	80½	74½
Brit. Elec. 1974/77	100	73½	− 1		3	4 1 9	79½	73½
Brit. Elec. 1976/79	100	77½		3½	3½	4 10 3	84	77½
Brit. Elec. 1974/79	100	88½		4½	4½	4 16 0	95	88
Overseas Electric Supply								
Calcutta Elec.	£1	19/6		6†	6†	6 3 0	20/9	19/-
East African Power	£1	19/-		7	7	7 7 3	21/3	19/6
Nigerian Elec.	£1	18/6	− 6d.	10	10	10 16 3	21/-	17/-
Palestine Elec. "A"	£1	21/-		Nil	Nil	Nil	21/-	21/-
Perak Hydro-Elec.	£1	16/-	+ 6d.	10	10	—	17/6	14/9
Equipment and Manufacturing								
Aberdare Cables	5/-	11/-		17½	17½	7 19 0	13/6	10/6
Aerialite	1/-	4/9	− 3d.	88½	45*	9 9 6	6/9	4/9
Allen, W. H.	£1	37/6		20	10*	5 6 8	39/-	33/6
Aron Elec. Ord.	£1	55/9		15	15	5 7 6	56/-	53/6
Assd. Automation	10/-	17/-		10	5	2 18 9	—	17/-
Assoc. Elec. Ord.	£1	66/3		14	15	4 10 6	85/6	57/9
Automatic Tel. & El.	£1	56/3		15	15	5 6 9	72/6	56/3
Babcock & Wilcox	£1	73/6		15	15	4 1 9	85/6	64/-
Baldwin, H. J.	2/-	4/9		20	20	8 8 6	5/-	3/9
Bakelite	10/-	27/6		16	16	5 16 6	34/-	26/9
Berry's Electric	5/-	6/6		—	10‡	7 13 9	6/6	5/9
British Aluminium	£1	65/9	+ 4/6	12	12	3 13 0	65/-	40/6
B.I. Callender's	£1	50/-		10	12½	5 0 0	54/3	45/-
B.I. Callender's 6% Pref.	£1	20/6		6	6	5 17 0	22/6	20/3
British Thermostat	5/-	25/-	− 1/3	20	25	5 0 0	31/9	24/6
British Vac. Cleaner	5/-	6/-		30	15*	12 10 0	8/9	6/-
Brook Motors	10/-	36/3		20	25	6 18 0	44/-	36/3
Brush Ord.	5/-	5/9		10	10	8 14 0	7/9	5/9
Bulgin, A. F.	1/-	4/9		45	50	—	5/3	4/3
Burco Dean	5/-	8/6		—	22½	13 4 9	13/3	8/6
Chloride El. Storage "A"	£1	61/3	− 2/-	17½	17½	5 14 3	73/6	60/9
Clarke Chapman	£1	105/-	− 2/6	20	22½	4 5 9	112 6	89/6
Cole, E. K.	5/-	15/6	− 6d.	17½	17½	5 13 0	22/3	15/6
Cossor, A. C.	5/-	6/9	− 3d.	10	15	11 2 3	10/3	6/9
Crabtree	10/-	27/-	− 1/-	20	20	7 8 3	29/3	27/-
Crompton Parkinson Ord.	5/-	13/9		20	16*	5 16 3	15/-	12/3
De La Rue	5/-	18/3	+ 3d.	30	30	8 4 6	20/3	15/-
Decca	4/-	26/3	− 9d	56½	43¾*	6 13 3	44/9	24/9
Desoutter	5/-	29/-	+ 1/3	25	30	5 3 6	32/9	25/9
Dewhurst	2/-	6/6	− 9d	24	30	—	7/6	5/3
Dictograph Tel.	2/-	5/9		20	20	6 19 3	6/9	5/9
Dubilier Condenser	1/-	3/9		25	25*	6 13 3	4/6	3/6
E.M.I.	10/-	26/6		10	15	5 13 3	37/-	26/3
Electrical Components	5/-	12/6		20	25	10 0 0	16/-	12/6
Elec. Construction	£1	25/3	− 1/-	8½	8½	6 14 9	29/9	25/-
Enfield Cable Ord.	£1	13/6	− 1/-	Nil	Nil	Nil	19/3	13/6
English Electric	£1	51/3		12½	12½	4 17 6	66/3	47/3
English Electric 3¾% Pref.	£1	13/-		3¾	3¾	5 15 6	14/6	12/6
Ericsson Tel.	5/-	35/6		20†	20†	2 16 3†	42/9	33/6
Ever Ready	5/-	25/9	− 1/3	35	35	6 16 0	32/9	24/-
Falk Stadelmann	£1	36/3	− 6d.	15	17½	9 13 0	45/9	36/9
G.E.C. Ord.	£1	53/9		12½	14	5 4 3	65/6	50/-
G.E.C. 6½% Pref.	£1	22/6		6½	6½	5 15 6	23/9	21/3
General Cables	5/-	11/3		30	30	13 6 9	13/9	11/3
Greenwood & Batley	£1	47/6		17½	17½	7 7 3	47/6	45/-
Hackbridge Cable	5/-	22/3		20	25	5 12 3	24/6	18/9
Hackbridge & Hewittic	5/-	18/3	− 6d.	30	23*	6 6 0	22/-	17/3
Heatrae	2/-	3/9 x.d.		15	15	8 0 0	5/1	3/9
Henley's	10/-	16/3		10½	11½	7 1 6	19/9	14/-
Holophane	5/-	19/9	+ 1/-	25	30	7 12 0	19/9	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
*After scrip issue. †Free of income tax. ‡Dividend forecast.

Beatty, the company is connected with the A.E.I.-John Thompson Nuclear Energy Company.

B.E.T. and I.T.V.

An interesting part of the annual report from British Electric Traction refers to an extension of the group's interests in Associated-Rediffusion, the company which runs the London weekday commercial television programmes, and in Broadcast Relay Service, which also has investments in that enterprise. These increases are stated to account for the greater part of the rise of over a million in the balance-sheet total of holdings in associated companies, now standing at £18.1 million. Combined assets of the group amount to over £38 million. Net profits for the year ended in March improved from £1.7 to £1.9 million, and enabled the company comfortably to maintain the dividend on the deferred stock at the previous rate of 22½ per cent. The 5s "A" (non-voting) shares are quoted around 17s 6d to yield 6¼ per cent. A return of 7 per cent is shown by the 8 per cent preferred ordinary shares.

Electrical Investments

Company or Board	Nom. Value	Middle price 9th July	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Equipment and Manufacturing—continued								
Hoover	5/-	25/-	− 1/-	70	50	10 0 0	39/3	23/-
I.C.I.	£1	43/6	+ 9d	10	10	4 12 0	49/9	41/3
Intl. Combustion	5/-	18/6	− 1/-	25	20*	5 8 0	25/-	15/3
Johnson & Phillips	£1	40/9		15	15	7 7 3	46/6	37/6
Lancashire Dynamo	£1	42/6		15	11*	5 3 6	49/9	40/9
Laurence, Scott	5/-	15/6		12½	15	4 16 9	16/9	13/3
Lister, R. A.	£1	30/-	− 1/3	9.3	10	6 13 3	35/3	27/6
London Elec. Wire	£1	50/-	− 9d	12½	12½	5 0 0	52/9	46/5
Lucas, J.	£1	29/6		7½	7½	5 1 9	40/3	29/6
Marryat & Scott	2/-	11/3	+ 3d	30	30	5 6 9	11/3	9/6
Mather & Platt	£1	51/6	− 1/-	13.6*	15	5 16 6	65/3	51/6
Metal Industries	£1	18/-	− 6d	9	9	—	27/-	16/3
Midland Elec. Mfg.	£1	45/-	− 1/3	10	12½	5 11 0	48/6	43/6
Morphy-Richards	4/-	20/-		35	50	10 0 0	27/3	20/-
Murex	£1	68/3		15	20	5 17 3	70/3	60/-
Newman Ind.	2/-	2/6		10	10	8 0 0	2/9	2/1
Oldham & Son	1/-	2/3		17½	20	—	3/-	2/3
Parnall (Yate)	5/-	5/9	− 3d	14	12	10 8 9	9,6	5/6
Parsons, C. A.	£1	80/-	− 5/-	10	10	2 10 0	85/-	61/6
Plessey	10/-	67/6	− 1/6	27½	30‡	4 9 0	87/6	56/-
Pye "A" Deferred	5/-	16/3	− 1/3	20	12½*	3 17 0	21/3	14/-
Revo	10/-	13/9 x.d.		9	9	6 11 0	14/6	8/3
Reyrolle	£1	100/-	− 5/-	15	16½	3 5 0	110/-	81/-
Rheostatic	4/-	9/-		18½	12‡	5 6 9	—	8/3
Richardsons Westgarth	5/-	15/6	− 6d	16‡	16‡	5 7 6	17/-	13/9
Scottish Cables	4/-	16/3		27½	27½	6 15 3	17/9	15/9
Smith (England), S.	4/-	10/6	− 1/-	17½	17½	6 13 3	14/3	10/6
Southern Areas	£1	17/6		10	7½	8 11 6	28/9	17/6
Strand Elec.	5/-	7/3	− 6d	17½	15*	10 6 9	8/6	7/3
Sturtevant	5/-	22/6	− 3d	14.4†	15†	3 6 9†	31/3	22/6
Sun Elec.	£1	35/-		15	20	11 8 9	37/6	35/-
Switchgear & Cowans	5/-	13/9		20	25	9 1 9	17/-	13/6
Taylor Tunnicliff	5/-	12/3		15	15	6 2 6	14/-	11/3
T.C.C.	10/-	43/-	− 3d	25	25	5 16 3	45/-	40/6
T.C. & M.	£1	28/-		8½	8½	6 1 6	34/-	26/-
Telephone Mfg.	5/-	7/-	− 6d	10	10*	7 2 9	8/6	6/3
Thorn Elec.	5/-	17/6		20	15*	4 5 9	22/6	16/-
Thornycroft	£1	42/6	− 1/3	15	15*	7 1 3	49/9	41/3
Tube Investments	£1	55/-	− 1/3	22½	14*‡	5 1 9	70/6	54/9
Vactric	5/-	12/-x.d.		15	17½*	7 5 9	15/-	11/6
Veritys	5/-	7/-	− 1/3	12½	12½	8 18 6	10/-	6/9
Walsall Conduits	4/-	12/9	− 6d.	70	20*	6 5 6	13/6	10/9
Ward & Godstone	5/-	33/9x.d.		30	35	5 3 9	38/3	29/-
Watford	2/-	6/3	− 3d	25	25	8 0 0	7/6	6/3
Westinghouse	£1	72/6	− 1/3	18	18	4 19 3	100/-	71/6
West, Allen	5/-	12/3	− 3d	15	15	6 2 6	14/6	11/6
Wolf Electric	5/-	17/6		20	20	5 14 3	26/3	17/6
Trusts, Transport and Communications								
Anglo-Am. Tel.:								
A. Ord.	100	74		6	6	8 2 3	80	66
Ord.	100	47½		3½	3½	7 18 0	54	45
Anglo-Portuguese	£1	23/-		8	8	6 19 3	23/6	20/3
Brit. Elec. Traction:								
Def. Ord. "A"	5/-	17/-		22½	22½	6 12 3	20/-	15/6
Cable & Wireless:								
Ord.	5/-	10/-	− 9d	10	10	5 0 0	11/3	9/6
4% Loan	100	90½		4	4	4 8 6	92½	88
Calcutta Trams	£1	25/-		6†	7½†	6 0 0†	26/3	23/-
Cape Elec. Trams	£1	18/3		5½	7½	8 4 6	20/3	18/-
Marconi Marine	£1	31/6		10	10	6 7 0	34/-	31/-
Oriental Tel. Ord.	1/-	70/-	+ 2/6	16	—	—	90/-	67/6
Telephone Rentals	5/-	10/9		12½	12½	5 16 3	11/9	9/9

British Tabulating Capital

British Tabulating Machine have secured official consent to an issue of ordinary capital. New £1 shares are to be offered shortly by way of rights to present shareholders, in the proportion of one for every three held, at a price of 27s. With the existing shares at 44s 3d, having been marked down fairly sharply since the announcement, the value of the rights worked out at approximately 4s 3d per share. Other news from this company during the course of this year has included the arrangement for loans up to £2 million from the Finance Corporation for Industry; the foundation of a new enterprise, to be owned jointly with G.E.C., for the development of computers and similar equipment, particularly in the fields of office machinery and automation; and an arrangement on similar lines with an American electronics firm.

Berry's Electric

Annual results now published by Berry's Electric Magicoal are the first to appear since the introduction of the shares to the market last March. At 6s 6d the 5s ordinary shares stand about 9d above the price at which initial dealings took place. Particulars published at the time of the issue estimated that profits for the year to March of this year would be at least equal to the 1954-5 figure of £133,000. In the event, the surplus comes out at £144,000, subject to tax of £70,000. Since most of the profit was earned before the formation of the present company, no dividend is being paid at this stage. The intention originally declared, subject to the maintenance of profits, was to distribute 10 per cent for the year now running. On this basis, there is a prospective yield of just on 7¾ per cent.

Stock on Offer

Among preference shares on offer there have been sizeable lines of Anglo Portuguese Telephone 6 per cents at 19s 6d and of Murphy Radio 5½ per cents at 17s 3d, both yielding a fraction over 6 per cent. G.E.C. 4½ per cent preference have been available at 15s 6d and Babcock & Wilcox "fives" at 17s 3d, the yields being respectively 5½ and 5¾ per cent. A return of 6 per cent is shown by E. K. Cole 5½ per cent Preference at 18s 3d and Vactric "sixes" at 13s pay 9¼ per cent on the money.

Brazil's 1956-60 Programme

From Our Rio de Janeiro Correspondent

PRESIDENT KUBITSCHECK has announced his plans to increase power supplies, improve transport and expand agricultural production in Brazil. With the co-operation of private enterprise, the installed capacity of generating plant is to be raised to 5,000,000 kW by 1960 and work started for an increase to 8,000,000 kW by 1965. The President considers these the absolute minima required to maintain industrial development at a reasonable level. Installed capacity rose by 9.3 per cent in 1954-55 to 3,016,920 kW, and production by 12.8 per cent to 13,180 million kWh.

At current prices the cost of installing and distributing 2,000,000 kW is estimated at 40,000 million cruzeiros in national and U.S.$400 million in foreign currencies. As the resources of Federal and State electrification funds will not exceed 20,000 million cruzeiros during the next five years, approximately 50 per cent of the local, and approximately the same proportion of the foreign, currency expenditure will be left to private enterprise. As far as Government imports are concerned, offers to supply capital goods on credit terms are coming in freely from the U.S.A., Europe and Japan.

The co-operation of private companies seems assured. Empresas Electricas Brasileiras, affiliated to American & Foreign Power, has completed plans to increase capacity by 410,000 kW to 867,000 kW by 1961. Imports would be financed by an Export-Import Bank loan.

The programme includes important work in Minas Gerais, Parana, Rio Grande do Sul, Bahia, Espirito Santo, Rio de Janeiro, Alagoas and Rio Grande do Norte. Four 40,000 kW generators are to be installed at the Companhia Paulista's Peivoto hydraulic station, in addition to two units of this rating to be inaugurated in 1957. Forca e Luz de Minas Gerais will install two 40,000 kW sets at Praia. Peixoto and Praia are on the Grande River, which divides Sao Paulo from Minas Gerais.

Brazilian Traction Light & Power completed the installation of four 65,000 kW generators at the Cubatao underground station in 1955 and plans to install plants at Ponte Coberta, Ribeira, Ribeirao, Sapucaia and Sete Quedas.

State-Sponsored Schemes

Throughout Brazil, State Governments are carrying out expansion programmes, usually assisted by Federal grants or loans from the National Bank for Economic Development (B.N.D.E.). In the Amapa Territory, adjoining French Guiana, now developing rapidly as a result of the exploitation of valuable manganese reserves by Bethlehem Steel, a "mixed-economy society" has been formed to build a 50,000 h.p. station on the Araguari River and in Para the local government is installing a 5,000 kW plant at Val-de-Caens. The Rio State authorities have inaugurated 800 kW thermal stations at Angra dos Reis, Cabo Frio and Ararauma and obtained a B.N.D.E. loan to complete the Macabu station. Goias has received a Federal grant to proceed with a hydraulic station at the Douarado Falls and the new Government of Espirito Santo has speeded up work on the Santa Maria River; stations are to be built at Rio Bonito, 17,600 kW, Timbu-Seco, 13,400 kW, Suica, 52,000 kW and Santa Leopoldina, 20,000 kW.

In South Brazil Santa Catarina has created an Electrification Fund, approved development plans and is investigating the resources of the Itajoca and Negrinha rivers, estimated at 130,000 h.p. Parana is building stations at Itarare and Salto Grande, on the Paranapanema, and has approved long-term projects for others at Cavernoso, Sao Joao, Zigueira, Maringa, Paranagua, Matinhos and Apucarana. This State has agreed to co-operate with Sao Paulo in utilising the power of the Paranapanema River.

Various autonomous agencies, created by the 1946 Constitution and financed by fixed percentages of the Federal revenue from taxation, are investing in electrification schemes. The Commissioners for the Economic Development of the Amazon and Sao Francisco Basins will spend 245 million cruzeiros this year; the National Health Service and the Irrigation Works Department are to invest 242 million and 60 million cruzeiros.

The State-owned Hydroelectric de Sao Francisco is now entering on the second stage of its programme. In 1955 it completed the installation of 180,000 kW at Paulo Afonso and 20,000 kW at Cotegipe. The next stage includes the building of a second underground power house at Paulo Afonso, and the duplication and extension of transmission lines to serve other areas. An abundant supply of electricity is attracting important electro-chemical and metallurgical industries to the undeveloped north-east.

Sao Francisco Valley Development

In June President Kubitscheck approved a contract between Minas Gerais and the Sao Francisco Valley Commission for building a dam and power station at Tres Marias. The costs of dam and power station are estimated at 3,700 million and 3,800 million cruzeiros, respectively, the former expenditure to be borne by the Commission and the latter by Centrais Electricas de Minas Gerais.

The project, drawn up by Morrison Knudsen, provides for a dam 74m high and 2,000m long, said to be one of the world's three largest. It will store 22,000 million cu metres of water, regulate the flow of the Sao Francisco River, irrigate 1,300 sq km of marginal lands and provide power for eight 110,000 kW stations, thereby benefiting five States. The dam should be completed in four to six years.

Several proposals to utilise new sources of hydraulic power are now under consideration. The Economic Development Council is studying a project, drawn up by Centrais Electricas de Minas Gerais, to build a dam at the Furnas Falls, on the Rio Grande, and supply up to 1,000,000 kW to the Belo Horizonte, Sao Paulo, Rio systems, which absorb three-quarters of Brazil's total power supply. The cost is estimated at 8,100 million cruzeiros.

The National Electrical Board has completed plans to utilise the potential of the "Estreito" region of the Uruguay River, which divides Rio Grande do Sul from Santa Catarina. The project is to build, near the first cataract, a dam and power station, the latter with an initial capacity of 97,000 h.p., to be raised later to 194,000. The cost is estimated at 1,000 million cruzeiros.

To ensure funds for President Kubitscheck's plans, despite the Government's financial difficulties, all public service tariffs are being increased so as to prevent heavy budget deficits. Electricity companies will be authorised to increase charges in order to earn a reasonable margin of profit and interest private capital, foreign and national, in power installations.

Classification of Insulating Materials

Review of B.S. 2757 : 1956

By R. SNADOW, B.Sc., F.R.I.C.*

MATERIALS that can be destroyed by burning, and also some that are non-inflammable, deteriorate slowly but steadily at the relatively modest temperatures attained by the windings of transformers, motors and other electrical equipment. This behaviour limits the useful life of much electrical insulation and, consequently, of the apparatus in which it is used. The actual rate of heat-ageing is strongly dependent upon temperature, and the life of apparatus can generally be prolonged by reducing the temperature at which it is operated. To achieve this, however, without reducing the rating, it is necessary to increase the quantities of constructional materials used and so to put up the size and weight of the apparatus as well as its cost. It is necessary to strike a reasonable balance between these opposed requirements and to arrive at an optimum service temperature.

This temperature will not be the same for all insulating materials because their susceptibility to heat-ageing differs from one to another. Some, such as varnished cotton, have been found to have a satisfactory life when their maximum temperature in the windings of motors, transformers and similar equipment is limited to 105 deg C while others, such as silicone-treated woven glass, appear to last as long when used in the same way at 180 deg C. To employ insulating materials to best advantage it has been found desirable to classify them according to their thermal stability and Class A and Class B, the two commonest classes, have become very well known as designations not only of insulating materials but also of equipment made up with insulation drawn from these classes.

Many British Standards for electrical apparatus refer to the classification of insulating materials given in Publication 34 of the International Electrotechnical Commission. This classification has found wide acceptance both in this country and throughout the world, but the last edition of Publication 34 is dated 1935 and, since then, numerous new synthetic insulating materials have been developed and have had the effect of rendering the old I.E.C. classification obsolescent. This has been appreciated at the international level and new I.E.C. recommendations for the classification of insulating materials have now been approved and will soon be issued.

B.S. 2757:1956, "Classification of Insulating Materials for Electrical Machinery and Apparatus on the Basis of Thermal Stability in Service," which has recently been published, is the first British Standard to be devoted to this subject and follows the latest I.E.C. recommendations closely. It is intended to be used in the preparation and revision of individual standards for electrical apparatus and consulted as a guide by manufacturers and others who are concerned with the selection of insulating materials.

New Classes of Insulation

Three new classes of insulation are introduced including Class H, which has previously been familiar to us from its use in American standards and has already been applied in this country too. In addition, the designation of the lowest temperature class has been changed from O to Y in order to avoid confusion with the figure zero. To each class a temperature is assigned which is the maximum temperature that insulation of that class should be permitted to attain in service for it to have an economic life in a wide range of apparatus under usual operating conditions.

The classes and their assigned temperatures are:—

Class	Temperature (deg C)
Y (formerly O)	90
A	105
E (new class)	120
B	130
F (new class)	155
H (new class for I.E.C.)	180
C	above 180

It is not to be expected that all types of apparatus will become available in each of the new classes. In some cases a new class may be standardised in place of an existing one, e.g. some Class A motors may, perhaps, be superseded by Class E motors. In other cases there may be no demand for changing the existing apparatus standard.

Thermal Stability

Materials qualify for inclusion in a particular class on the basis of their ability to withstand the class temperature as indicated by service experience or thermal endurance tests, and a section of the publication is devoted to a general account of the types of test useful for this purpose. This is a radical but necessary departure from the superseded classification which was based upon the chemical composition of materials. Adequate service experience is available to allow some of the commoner materials coming within the older classes to be named in the broad description of the classes which is given. This also applies to Class H, which refers to silicone elastomer and resins. However, examples of bonding substances used with mica, etc., to form typical Class B materials are not specified.

No doubt some disappointment will be felt when this classification is first examined because the amount of precise information provided regarding which materials come into the various classes is so meagre. An appendix to the document lists materials which may be considered appropriate to each class but it is made clear that this is intended as a general guide only and the use of materials in this way is not mandatory. This vagueness is inescapable because the suitability of a particular insulant for use in a given class may depend on the way it is used, e.g. how highly it is electrically or mechanically stressed; if the stress is low failure may not occur until a very considerable degree of deterioration due to heat-ageing has taken place. The compatibility of materials with one another also influences their thermal stability; this can be particularly important for combinations of enamelled wire and impregnating varnish. Another consideration which detracts from the usefulness of lists of materials is that some of these can be obtained in a number of varieties of different thermal stability, e.g. a wide range of formulations would fulfil the description "alkyd resin." It is of course obvious that the lists given are not, and cannot be, comprehensive and the fact that mention of a material is omitted from a particular class is not an indication of unsuitability. The appendix provides a first approximation to the solution of the problem facing those who have to select insulation for a particular duty but makes it clear that only experience

* Research Laboratory, British Thomson-Houston Co., Ltd., Rugby.

or adequate tests relevant to that duty can provide a final answer.

It would be helpful to be given details of suitable tests for assessing the thermal endurance of insulation for particular assemblies. There is much activity in this field and a number of papers, particularly in the U.S.A., have been published on the subject, but it is too early yet to reach agreement on which tests should be adopted, though it may be anticipated that future revisions of the document will give this type of information.

Permissible temperature rises for machines, transformers or other equipment are not directly within the scope of the publication. They are the responsibility of engineers drawing up standards for apparatus. The temperatures assigned to insulation classes are, however, relevant to such considerations and, for most apparatus, maximum temperature rises will no doubt be specified such that the hottest spot of the windings will not exceed the appropriate insulation class temperature when due allowance is made for the ambient temperature, and for the margin between the hottest spot and the temperature of the part measured. For some apparatus higher temperature rises may be specified without conflicting with the new classification. This is envisaged in the document where special circumstances apply and will be appropriate to, e.g. contactor coils. Experience has shown that for an equal length of life, these can operate at much higher temperatures than the windings of motors and transformers. Other reasons for legislating for maximum temperatures in excess of the class temperature might be provided by apparatus that is at its peak load for an abnormally small proportion of its running time, or by cases where a shorter service life is acceptable in return for a saving in weight. On the other hand, where a longer operating life than usual is demanded, it may be preferred to keep the maximum permitted temperature below the class temperature.

There is much useful information about the behaviour of insulating materials to be found between the covers of B.S. 2757 but there are no instructions that can be followed automatically. Seven classes of insulating materials are designated and standardised by reference to a class temperature but the proper use of the document will call for a great deal of intelligent and conscientious interpretation. Given this, the classification should result in a more effective and economic use of insulating materials and electrical apparatus.

ATOMIC POWER IN INDIA

From Our Indian Correspondent

INDIA and Japan are probably the only two countries in "free" Asia with a co-ordinated atomic development programme. In India, the development is to be carried forward substantially under the latest five-year plan approved by the Government and now being put into effect by the Atomic Energy Commission. The Commission has just entered into an agreement with the Canadian Government for the establishment of an atomic reactor project under the Colombo Plan. The project will be a joint enterprise, the costs and responsibilities being shared equally between the two countries. The reactor will be a high power reactor of the Canadian NRX type and is expected to go into operation by 1958. It will be a very powerful research tool and will enable India to undertake advanced engineering research and materials testing connected with more advanced types of power reactors. It will use heavy water as moderator so as to produce intense neutron flux; the heavy water will be supplied by the United States. The project, the biggest under the Commission's present activities, will cost about Rs.7 crores* half of which will be met by Canada. Work on the project has already begun at Trombay, a few miles north of Bombay, where other divisions of the Commission are soon to be transferred, making it the atomic "capital" of India.

This is not the first reactor to be built in India, however. A "swimming pool" reactor designed and constructed by Indian scientists and engineers has been in partial operation from the beginning of this year. It is primarily a research reactor using ordinary water as moderator, the fuel elements being obtained from the United Kingdom.

Besides pure research, the Commission is at present engaged in two principal activities, viz. prospecting for minerals of use in atomic energy and industrial operations. The raw materials division has made extensive reconnaissance surveys followed by geological and drilling investigations which have revealed large deposits of monazite in South India, and a number of new deposits of columbite, tantalite, beryl and uranium bearing minerals in the Bihar mica belt and Rajasthan.

* Rs.1 crore = £750,000.

The Commission operates a number of industrial projects. In Travancore-Cochin, the plant of the Indian Rare Earths, Ltd., has been in production since 1952 at Alwaye where it processes the monazite sands for the production of rare earth products and trisodium phosphate. It has now been decided to increase its processing capacity from 1,500 tons to 3,000 tons of monazite per annum. The residual thorium-uranium cake is sent up for further processing to the Trombay plant which commenced production in August, 1955. The capacity has since been increased fivefold to feed the proposed uranium processing plant. The fuel value of the thorium and uranium produced at the Trombay plant will be equivalent to about a thousand million tons of coal per annum or roughly four times the coal production of the United Kingdom. The uranium processing plant has not yet been set up but the project is expected to be completed very soon. A pilot plant for the extraction of the uranium ore from the copper tailings of the British-owned Indian Copper Corporation at Ghatsila near Jamshedpur, in Bihar, is being set up with a capacity of about 200 tons of tailings a day. Another important project will be the heavy water-fertiliser plant at Nangal which will utilise the power from the Bhakra Dam. Project reports are being prepared by the Vitro Engineering Division and St. Gobain, Chauny & Cirey. A report on heavy water production at Nangal, Sindri and other places is being prepared by Costain-John Brown.

Unlike other under-developed countries, India sets great store by atomic energy and is already thinking in terms of producing nuclear power within the next five or six years. The Minister for Power and Irrigation said recently that negotiations were proceeding apace for the setting up of a reactor and power station and although the country was not mentioned by name a reference to the United States may not have been accidental. India's coal resources are limited and most will be needed for her metallurgical industries. Hydro power is affected by the irregularity of monsoons. All these reasons may lead her to rely upon thorium—of which she has extensive deposits—for power generation.

NEW ELECTRICAL EQUIPMENT

Aluminium Finishing Process

Providing a product which is comparable in finish, more durable and, in many cases, cheaper than the majority of chromium plated articles, the "Erftwerk" process is now available in this country on a commercial basis. This is a simple and economical method of chemically brightening aluminium, originally developed in Germany, and the process is to be operated under licence by the LONDON ALUMINIUM CO., LTD., of Witton, Birmingham.

Components are immersed in a solution which consists in the main of ammonium bifluoride and nitric acid. The rate of attack on the metal is very high and brightening is achieved within 20 to 30 seconds. Careful prepolishing is not essential. After brightening, components are given a special anodising treatment, at high voltage and low temperature, in a sulphuric acid electrolyte and the anodic film is then sealed in boiling water. If desired this film can be given any required colour, by immersion in a dye vat, prior to sealing. The hard transparent oxide film which has been formed gives protection against attack from the worst industrial and marine atmospheres.

Inspection Lamp

An inexpensive and versatile inspection lamp (3HT20) has just been introduced by CHLORIDE BATTERIES, LTD., Clifton Junction, Swinton, Manchester. The reflector housing, normally clipped to the battery container, can be worn on the forehead to leave both hands free. The elastic headband for this purpose is carried in the case when not in use. A belt clip and button attachment is also provided. The lamp is finished in silver grey and chromium and is operated by three "Drydex" T20 cells. Fitted with a pre-focus bulb (a spare is carried in the case) it is priced at £1 5s, plus 4s 10d purchase tax in the United Kingdom.

Diesel Starter Batteries

The D.P. BATTERY CO., LTD., Bakewell, Derbyshire, has developed a new range of batteries for diesel engine starting. Known as the Kathanode "R" series, they offer a higher performance than the Kathanode "D" range and achieve savings in weight, size and cost of about 15 per cent. The high capacity positive plates are of the flat pasted type with a robust grid construction designed for continuous service involving high rates of discharge and the lightweight negative plates are designed to have the same working life as the positives. Plate separation is achieved by sheets of "Porvic" microporous plastic and felted glass wool. A further function of the glass wool is to retain the positive active material whilst allowing free diffusion of acid and escape of gas. Its effect on the cell's internal resistance is negligible. The plate groups are housed in strong hard rubber containers and sealed with moulded lids fitted with improved bayonet-type vent plugs.

Light-Spot Wattmeter

A new Hartmann and Braun light-spot wattmeter is now available from KANDEM ELECTRICAL, LTD., 711 & 715, Fulham Road, London, S.W.6. This is of interest to the electricity supply industry for the testing and calibrating of electric meters and wattmeters for supply measurement.

The accuracy of indication for d.c. and a.c. is within a limit of error of ±0·1 per cent; the current path withstands four times the rated current permanently if there is an overload in the voltage path of 100 per cent and the voltage path withstands permanently twice the rated voltage when the current path is overloaded by 300 per cent.

The iron screened electrodynamic measuring system employed can be placed near machines or transformers in the range of strong external fields, the power measurements taken still being accurate. The components of the wattmeter are supported by a robust cast iron chassis.

Direct Reading Magnetometer

The latest equipment to be introduced to the range of electronic instruments made by NEWPORT INSTRUMENTS (SCIENTIFIC & MOBILE), LTD., Newport Pagnell, Bucks, is a direct reading magnetometer. This has been designed to measure fields from 0·1 to 500 oersteds with one probe. Selection of the range required is by means of a front panel switch and applications will be in the transformer, radio and television fields. Further applications may exist in servo motor testing, for examining focusing electromagnets associated with particle accelerators, and for experiments associated with measuring the earth's field. The instrument will be available shortly and the anticipated selling price is £97 complete with one probe.

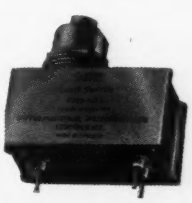
Ventilating Fan

HILLMAN ELECTRIC MOTORS, LTD., 2-3, Northwold Buildings, Stoke Newington, N.16, are now producing the "Comet" fan for the ventilation of offices, small workrooms, etc. For everyday requirements this is suitable for rooms up to 5,000 cu ft and gives three changes of air an hour. It is quiet running and the plain self-oiling bearings ensure that the motor will not require attention for a number of years. The 7½in diameter fan moves 250 cu ft per minute and absorbs only 26 W. It is supplied for operation on single-phase 100/110, 200/220, 230/250 V 50 c/s. The fans have a four-lug mounting ring and the weight is 5½ lb.

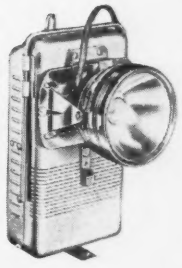
Limit Switch

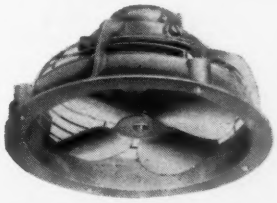
SMITHS INDUSTRIAL INSTRUMENTS, LTD., North Circular Road, London, N.W.2, have added a new limit switch to their large range of instruments. This is hermetically sealed against the ingress of water, dust and oil, and is claimed to have a long trouble-free life under adverse conditions. It can be supplied in either the form illustrated, or mounted on a single base or in a bank of four. The switches are available for currents up to 5 A at 250 V a.c. or 2 A 250 V d.c. The operating force is 5½ lb, the over-travel 0·250in and the maximum over-travel force 30 lb.

Chloride Batteries 3HT20 "Drydex" inspection lamp



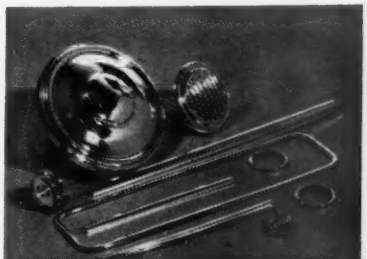
Smiths limit switch





The "Comet" fan

Aluminium fittings chemically brightened by the "Erftwerk" process



DOMESTIC ELECTRICAL EQUIPMENT

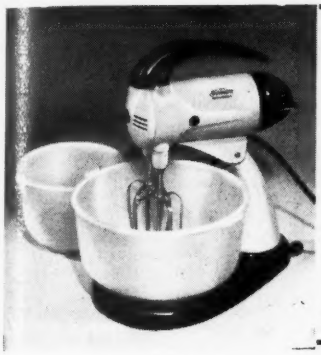
Food Mixers

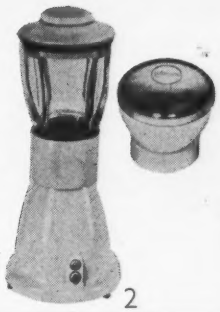
MUCH of the hard work entailed in the preparation of food in the kitchen can be eliminated by the use of an electric food mixer and in addition the scope of dishes and beverages can be extended. Operations can be carried out in a fraction of the time taken by hand and an important factor in relation to hygiene is that with the use of mixers the actual handling of food is reduced to the minimum.

The usual attachments supplied with a food mixer include a pair of beaters, whisks, dough hooks and the mixing bowls, but in addition there is a wide range of attachments available which can be added from time to time to give the appliance a greater all-round usefulness. These additional attachments perform a wide variety of functions and include juice extractors, meat mincers, coffee mills, slicers and shredders, potato peelers, and even can openers. Many of the larger models incorporate a speed control knob enabling the user to set the attachments to a speed suitable for their specific operation.

Prices vary according to their size, most full-size machines, without accessories, costing between £25 and £30, but there are portable mixers selling below £8, including purchase tax.

Manufacturer	Name or Model	Capacity	Standard Equipment	Special Features	Finish
BROWN BROTHERS, LTD., Great Eastern Street, London, E.C.2.	" Duco "	Small bowl, 2 pint. Large bowl, 5 pint	Two glass mixing bowls	Beating speed variation, 250–750 r.p.m. T.V. interference suppressors	White enamel, black fittings and base
ENGLISH ELECTRIC CO., LTD., East Lancashire Road, Liverpool, 10.	" 5500 "	Small bowl, 2 pint. Large bowl, 5 pint	Two clip-in beaters, turntable and two ridged bowls	Portable mixer head, 20-speed control dial	Cream or white stoved enamel
FALK STADELMANN & CO., LTD., 91, Farringdon Road, London, E.C.1.	" U.95643 "	Small bowl, 2 pint. Large bowl, 4½ pint	Juice extractor, two beaters, turntable and two bowls	Variable speed control, anodised aluminium bowls	Cream enamelled body and turntable, black handle
HILLMAN ELECTRIC MOTORS, LTD., 2-3, Northwood Buildings, Northwood Road, London, N.16.	" Hillma-mix "	1 pint	Liquidiser	Portability, two-speed control	Red, blue, green, primrose, white or cream
KENWOOD ELECTRICS, LTD., 26, North Audley Street, London, W.1.	A.700 " Chef "	—	" K " beater, whisk, dough hook, glass bowl and plastic cover	Planetary mixing action, wide variety of attachments	Cream or white stoved enamel
	A.300 " Minor "	—	Two beaters, wall bracket	Portability, hangs on wall when not in use	White with black relief
	A.955 " Kenmix 55 "	1 litre	Liquidiser and power unit	Can be taken apart for easy cleaning	White stoved enamel
	A.500 " Roto-Blend "	1 litre	Power unit adaptor and juice separator	Three machines in one	White stoved enamel
MIDLAND REPETITION & AUTO MANUFACTURING CO., LTD., Bayton Road, Exhall, Coventry.	" Rapide Mixstir "	3 to 5 pints	Two bowls, two beaters and juice extractor	Governor controlled motor gives full power at any speed	White and black stoved enamel
SIROMA ENGINEERING CO., LTD., North Acton Road, Harlesden, N.W.10.	" FM4A "	Small bowl, 2 pint. Large bowl, 5 pint	Two bowls, two beaters and recipe book	Governor controlled motor gives speeds between 250 and 750 r.p.m.	White stoved enamel body, black base
SUNBEAM ELECTRIC, LTD., 14-16, Old Quebec Street, London, W.1.	" Mixmaster "	Small bowl, 2¾ pint. Large bowl, 6 pint	Two bowl-fit beaters, two bowls	Mix-finder dial, automatic speed control, portable use	White stoved enamel, black Bakelite mouldings
VALMADE, LTD., Browells Lane, Feltham, Middlesex.	" Valmix "	3 pint	Two beaters	Portability	Cream, green or red
A. E. WARNER (LONDON), LTD., 56, Brewer Street, London, W.1.	"Turmix 450"	¾ pint glass goblet ½ pint each metal goblets	Available as mixer, juice extractor, shredder or lemon squeezer	Automatic speed adjustment, 3,000, 8,000 or 12,000 r.p.m.	White





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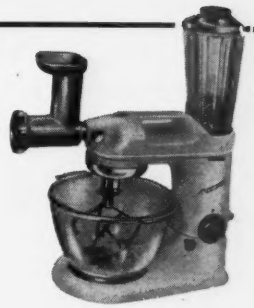

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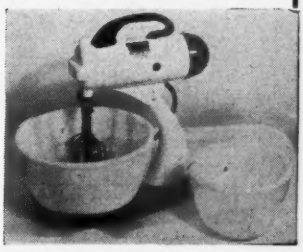

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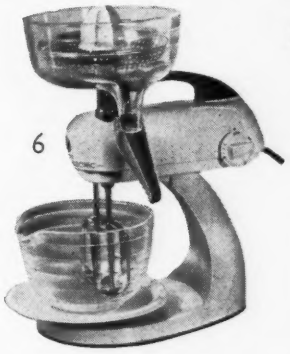

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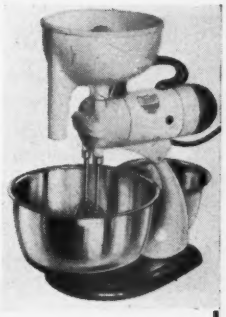

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Price (excl. P.T.)	Purchase Tax	Price of Accessories (excl. P.T.)	Purchase Tax on Accessories
£14 10 0	£6 7 6	£1 10 0 juice extractor £4 0 0 power gear unit £2 5 0 mincer £2 5 0 grater	£0 6 7 £0 17 6 £0 9 11 £0 9 11
£14 11 0	£6 7 8	£4 17 6 mincer £1 19 0 juice extractor	£1 1 5 £0 8 6
£18 0 0	£7 17 11	£4 15 6 power unit £2 11 6 mincer £2 11 6 grater	£1 1 0 £0 11 4 £0 11 4
£7 10 0	£3 6 0	£0 14 0 coffee mill	£0 6 0
£21 16 6	£9 11 6	* See below	* See below
£7 5 0	£3 3 8	—	—
£12 12 0	£5 10 7	—	—
£18 5 6	£8 0 4	£4 2 6 liquidiser £5 15 6 high-speed slicer and shredder	£0 18 1 £1 5 4
£18 7 6	£8 1 3	—	—
£14 10 0	£6 7 3	£1 10 0 juice extractor £4 0 0 power gear unit £2 5 0 mincer £2 5 0 grater	£0 6 7 £0 17 6 £0 9 10 £0 9 10
£16 15 8	£7 7 4	£5 3 4 blender £5 3 4 slicer and shredder £5 3 4 mincer £0 17 3 juice extractor	£1 2 8 £1 2 8 £1 2 8 £0 3 9
£5 12 0	£2 9 1	£0 12 6 mixer stand	£0 2 9
£32 10 0	£14 11 0	£3 10 0 lemon squeezer £5 10 0 juice extractor £7 10 0 shredder	£1 11 3 £2 8 0 £3 7 3

1. *Sunbeam "Mixmaster"*
2. *Hillman "Hillma-mix" with coffee mill attachment*
3. *Falk Stadelmann "U.95643"*
4. *Kenwood A.700 "Chef"*
5. *Siroma "FM4A"*
6. *English Electric "5500"*
7. *Brown Brothers "Duco"*
8. *A. E. Warner "Turmix 450" all-purpose mixer*
9. *Midland Repetition "Rapid Mixstir"*
10. *Valmade "Valmix"*

* Kenwood A.700 "Chef" accessories:—Juice extractor, £1 6s 6d (plus 5s 10d purchase tax); oil dripper, 3s 8d (10d); meat mincer, £2 13s 0d (11s 7d); liquidiser, £4 2s 6d (18s 1d); colander, £1 19s 6d (2s); coffee mill, £4 1s 6d (17s 11d); drive unit, £4 18s 6d (£1 1s 7d); juice separator, £4 (17s 7d); high-speed slicer and shredder, £5 15s 6d (£1 5s 4d); potato peeler, £4 2s 6d (18s 1d); can opener, £1 6s 4d (5s 10d); glass bowl, £1 1s 0d (3s 8d); slicer and shredder, £3 8s 6d (15s); stainless steel bowl, £3 13s 6d (12s 11d).

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 18th July from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1944

1220. Bauer, S. G., and Newell, R. E.—Atomic energy producing devices. 4th January, 1945. (753130.)

1952

5688. Reutter, J. L.—Synchronous oscillating compressors for a.c. 4th March, 1952. (753011.)

24059. General Electric Co.—Thermal insulation. 25th September, 1952. (752873.)

1953

15391. Standard Telephones & Cables, Ltd.—Low resistance connections to germanium. 28th May, 1954. (753131.)

15744. General Electric Co., Ltd., and Morris, G. G.—H.v. electric insulating bushings. 7th September, 1954. (753225.)

19879/80. Western Electric Co., Inc.—Semi-conductor electric signal translating devices. 17th July, 1953. (753013/4.)

23810. Standard Telephones & Cables, Ltd.—Dry rectifiers. 28th August, 1953. (753135.) 23811. Light cells or rectifiers. 28th August, 1953. (753136.)

23882. King, C. A. J.—Electric indicator lamps. 17th August, 1954. (753230.)

31547. English Electric Co., Ltd.—Control of feathering runner vanes of hydraulic turbines and pumps. 12th November, 1954. (753237.)

34063. Neale & Sons, Ltd., J., and Neale, D. W.—Securing of electric lamps on panels or sheets. 7th December, 1954. (753240.)

35197. British Thomson-Houston Co., Ltd.—Pulse generating electrical circuit arrangements. 17th December, 1954. (752883.)

1954

471. Philips Electrical Industries, Ltd.—Inductors for h.f. heating. 7th January, 1954. (752885.)

597. Philips Electrical Industries, Ltd.—Transistor circuit arrangements. 8th January, 1954. (753015.)

873. Reutter, J. L.—Synchronous a.c. oscillating compressors. 4th March, 1952. (753017.)

1140. Ernst, W. G.—Process for the production of electrically heated articles. 14th January, 1954. (752890.)

1250. Standard Telephones & Cables, Ltd.—Electric semi-conducting devices. 15th January, 1954. (753140.)

1272. Specialties Development Corporation.—Electric switch operable by deformation of the housing. 15th January, 1954. (753018.)

2191. Radio Heaters, Ltd.—Electric switching systems. 25th January, 1955. (752797.)

3040. Crossland, Ltd., R. & A. G., and Cocksedge, F. M.—Electric light fittings for use with tubular lamps. 4th January, 1955. (753022.)

3075. Automatic Electric Laboratories, Inc.—Switching circuits for automatic telephone systems. 2nd February, 1954. (753023.)

3497. Radio Corporation of America.—Magnetic switching devices. 5th February, 1954. (753025.)

4278. Telefonaktiebolaget L. M. Ericsson.—Crossbar switches. 12th February, 1954. (752902.)

4589. Compagnie Générale de Télégraphie sans Fil.—Automatic frequency regulation systems. 16th February, 1954. (752810.)

4643. Philips Electrical Industries, Ltd.—Devices for measuring electric power. 17th February, 1954. (752904.)

5129. Tesla, Narodni Podnik.—Non-chattering electric contact device particularly for high-speed electric relays. 22nd February, 1954. (752907.)

5321. General Electric Co.—Sound television receivers. 23rd February, 1954. (753030.)

5586. Valiulis, S. B.—Electrical terminal clip. 25th February, 1954. (753151.)

5721. English Electric Co., Ltd.—Multi-pole oil circuit-breakers. 25th February, 1955. (753034.)

5937/8. Naamlooze Vennootschap Hollandse Signaalapparaten.—Radar apparatus. 1st March, 1954. (753038/9.)

5954. Bendix Aviation Corporation.—Electric control system. 1st March, 1954. (752909.)

5977. Allis-Chalmers Manufacturing Co.—Electric power interrupting device employing a controller for regulating contact closing speeds. 1st March, 1954. (753152.)

6041. Telefunken Ges. für Drahtlose Telegraphie.—Radio receivers provided with time switch control devices. 2nd March, 1954. (752910.)

6528. Automatic Electric Laboratories, Inc.—Telephone system employing impulse responsive cross bar switches. 5th March, 1954. (752912.)

7021. Kolb, O. K. (Bender, W.).—Electric incandescent projection lamps. 10th March, 1954. (752916.)

7146. International Patents Trust, Ltd.—Electrical plug and socket connectors. 11th March, 1954. (752918.)

7628. Radio Corporation of America.—Television pick-up tube. 16th March, 1954. (753155.)

8100. Philips Electrical Industries, Ltd.—Magnetic or dielectric amplifiers. 19th March, 1954. (753255.)

8113. Standard Telephones & Cables, Ltd.—Method of etching germanium or silicon. 19th March, 1954. (753158.) 8697. Electric semi-conductor devices. 25th March, 1954. (753159.) 8926. Method of making P-N crystals of germanium or silicon semiconductors. 26th March, 1954. (753160.)

8176. Compagnie Générale de Télégraphie sans Fil.—Frequency modulated signal discriminators. 19th March, 1954. (753047.)

8707. Westinghouse Electric International Co.—Voltage reference networks. 25th March, 1954. (753046.)

9389. T.I. (Group Services), Ltd.—Electric generator. 17th March, 1955. (752928.)

11071. Compagnie Générale de Télégraphie sans Fil.—Frequency modulated radar systems. 14th April, 1954. (753058.)

11979. National Cash Register Co.—Magnetic switching device. 26th April, 1954. (753167.)

12017. General Electric Co.—Ionic vacuum pumps. 26th April, 1954. (753264.)

12977. British Thomson-Houston Co., Ltd.—Voltage regulating systems for alternators. 29th April, 1955. (753270.)

13062. Arrow Electric Switches, Ltd.—Electric switches particularly electromagnetic switches. 5th May, 1954. (753271.)

13564. Philips Electrical Industries, Ltd.—Systems for transmitting television or like images. 10th May, 1954. (753172.)

14078. Ultra Electric, Ltd.—Magnetostrictive delay lines. 13th May, 1954. (753274.)

14185. Standard Telephones & Cables, Ltd.—Control means for pulse distributors operating in synchronism. 14th May, 1954. (752843.)

14437. Allis-Chalmers Manufacturing Co.—Electric circuit-breaker with hydraulic motor controlled by a hydraulically biased valve. 17th May, 1954. (752947.)

15434. General Electric Co.—Transistor amplifiers. 25th May, 1954. (753079.)

15522. Electric Auto-Lite Co.—Condenser structure. 26th May, 1954. (752847.)

15676. Air Preheater Corporation.—Electrostatic precipitators. 27th May, 1954. (752958.)

15836. Standard Telephones & Cables, Ltd.—Arrangement for supervising television transmitters. 28th May, 1954. (753276.)

15877. Arcair Co.—Electric arc torches. 28th May, 1954. (753083.)

16095. British Thomson-Houston Co., Ltd.—Electric photographic flash lamps. 31st May, 1954. (752848.)

16420. Pirelli Soc. per Azioni.—Armoured submarine electric cables. 3rd June, 1954. (752849.)

16596. Western Electric Co., Inc.—Electrical wave transmission networks. 4th June, 1954. (753085.)

16746. Schweizerische Lokomotiv- und Maschinen-Fabrik.—Piezo-electric pressure transducer. 8th June, 1954. (752851.)

16929. Philips Electrical Industries, Ltd.—Cathodes for use in electric discharge tubes. 9th June, 1954. (753280.)

17619. S.W.F. Spezialfabrik für Auto-Zubehör Rau Ges.—Indicating lamp circuit comprising electrically driven switches. 15th June, 1954. (752855.)

18167. Yamauro, M., and Nakaseko, N.—Method of manufacturing porous tubes for electric storage battery plates. 21st June, 1954. (752967.)

18573. Globe-Union, Inc.—Seals between metal conductors and ceramic insulators. 24th June, 1954. (753088.)

18585. Huwyler, A.—Motor control system for monophase and polyphase a.c. motors. 24th June, 1954. (753195.)

19874. Mallory Batteries, Ltd.—Electric batteries, electrolytic condensers, rectifiers and other electrochemical cells. 7th July, 1954. (753090.)

20150. Standard Telephones & Cables, Ltd.—Tools for making electrical terminal connections. 9th July, 1954. (752861.)

20447. Benjamin Electric, Ltd.—Light-transmitting ceiling constructions. 13th July, 1954. (753093.)

20602. General Electric Co.—Control systems responsive to X-ray emission. 14th July, 1954. (752971.)

21933. Schrack-Elektrizitats-Akt.-Ges., E.—Electro-magnetic switch for d.c. or a.c. with high remanence magnetic system. 27th July, 1954. (752870.)

23561. Standard Telephones & Cables, Ltd.—Methods of sealing capacitors. 13th August, 1954. (753184.)

23592. Philips Electrical Industries, Ltd.—Amplifying cascades employing transistors. 13th August, 1954. (752981.)

23656. Babcock & Wilcox, Ltd.—Vapour generating and vapour heating units. 13th August, 1954. (753103.)

24310. British Thomson-Houston Co., Ltd.—Leak detecting apparatus for use with exhausting machinery. 20th August, 1954. (753185.)

24778. Sperry Corporation.—Electrical control of to-and-fro motion of heavy bodies. 25th August, 1954. (752986.)

25287. General Electric Co.—Thermal control means for electrical heating devices particularly cooking receptacles. 31st August, 1954. (752987.)

26039. General Electric Co.—Temperature responsive controls for electric discharge devices. 8th September, 1954. (752989.)

27959. International Business Machines Corporation.—Piezo-electric interrogation of ferroelectric data storage condensers. 28th September, 1954. (752993.)

[*Continued at foot of page 95*

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—1st August. Victorian Railways. Insulated copper cables. (E.S.B. 16448/56. Ten/20021.)*

Belfast.—10th August. City Electricity Department. 33 kV main cables, auxiliary cables and accessories, and 6·6 kV and auxiliary cables and accessories for substations. (See this issue.)

Colwyn Bay.—31st August. Borough Council. Street lighting equipment. (See this issue.)

Costa Rica.—20th July. Ferrocarril Electrico al Pacifico. Copper cables and 7,500 copper terminals. (E.S.B. 16999/56. Ten/20118.)*

Disley.—31st August. R.D.C. Street lighting equipment. (See this issue.)

Egypt.—25th July. Cairo Electricity and Gas Administration. V.r.i. cables. (E.S.B. 16750/56. Ten/20069.)*

Ethiopia.—24th July. Imperial Board of Telecommunications. Unarmoured and armoured telephone cable. (E.S.B. 16754/56. Ten/20070.)*

India.—6th August. Government of Andhra Department of Electricity. Hydro-electric turbo-alternator generating set and indoor switchgear for Tungabhadra Hampi power house. (E.S.B. 16634/56. Ten/20040.)*

10th August. Director General of Supplies and Disposals. Steel tape armoured cable. (E.S.B. 16663/56. Ten/20044.)* 21st August. Underground telephone cables. (E.S.B. 16661/56. Ten/20063.)*

31st July. Damodar Valley Corporation, Electricity Department. Phosphor bronze terminal connectors and aluminium busbar fittings for substations. (E.S.B. 16832/56. Ten/20142.)*

10th August. Government of Madras, Department of Electricity. Coal and ash handling plants for Basin Bridge "A" station. (E.S.B. 16800/56. Ten/20092.)*

NEW PATENTS (*continued*)

29053. Standard Telephones & Cables, Ltd.—Method of manufacturing germanium layer crystals. 8th October, 1954. (752996.)

29173. Hirschmann, R.—Electric insulators. 11th October, 1954. (752998.)

30033. Westinghouse Electric International Co.—Dynamo-electric machines. 19th October, 1954. (753114.)

30069. Soc. Alsacienne de Constructions Mécaniques.—Receivers for electric pulse code transmission systems. 19th October, 1954. (753115.)

32179. Automatic Telephone & Electric Co., Ltd.—Register-senders for use in telephone systems. 6th November, 1954. (753002.)

32251. Soc. Anon. de Machines Eléctrostatiques.—Electrostatic machines. 8th November, 1954. (753199.)

33562. Westinghouse Electric International Co.—Dynamo electric machines. 19th November, 1954. (753121.)

34768. Marconi's Wireless Telegraph Co., Ltd.—Piezo-electric resonators. 1st December, 1954. (753123.)

36222. Aktiebolaget Tudor.—Electric accumulators. 14th December, 1954. (753126.)

36624. General Electric Co.—Single axis gyroscopes. 17th December, 1954. (753127.)

36652. Marie, G. R. P.—Ultra high frequency amplifiers. 17th December, 1954. (753128.)

New Zealand.—20th July.—Auckland Electric Power Board. L.v. cable. (E.S.B. 16834/56. Ten/20104.)*

7th August. Christchurch Municipal Electricity Department. Ten 300 kVA transformers with spare bushings. (E.S.B. 16681/56. Ten/20033.)*

15th August. General Post Office. 50 lead acid cells. (E.S.B. 16617/56. Ten/20105.)* 2nd August. One hundred test sets. (E.S.B. 16994/56. Ten/20144.)*

7th September. Electricity Department, Dunedin City Corporation. Four 15 MVA, three-phase transformers. (E.S.B. 16991/56. Ten/20120.)* 5th October. 6·6 kV, 250 MVA switchgear and 33 kV outdoor circuit-breakers. (E.S.B. 16992/56. Ten/20121.)*

Newark-on-Trent.—31st August. Borough Council. Street lighting equipment. (See this issue.)

Northern Ireland.—23rd July. Northern Ireland Hospitals Authority. Electrical installation in a single-storey building, Coleraine Hospital. W. & M. Given, consulting engineers, Waterside, Londonderry.

Pakistan.—25th July. Posts and Telegraphs Department. Switchboard cable. (E.S.B. 16589/56. Ten/20051.)*

Rugby.—30th July. Borough Council. Electrical installation and voltage change-over at Avon Waterworks. (See this issue.)

Saddleworth.—23rd July. U.D.C. Street lighting equipment. (See this issue.)

Sunderland.—20th July. Corporation. Electrical installation at Castle View Infants' School. Borough architect, Grange House, Stockton Road.

Syria.—13th August. Director General of the Homs-Hama Electricity Undertaking. 1,100 kW generating set. (E.S.B. 16830/56. Ten/20101.)*

Tewkesbury.—21st July. Borough Council. Street lighting equipment. (See this issue.)

ORDERS PLACED

Birkenhead.—Welfare Committee. Passenger lift at Eastham House (£1,425).—Austin Lifts.

Farnworth (Lancs).—Corporation. Recommended. Wiring of 70 houses on the Plodder Lane South No. 2 housing site (£2,715).—Dawson & Gent.

Glasgow.—Health and Welfare Committee. Electrical installation at Merrylee aged persons' home (£1,826).—Edgar & Mellan. Electric passenger/bed lift (£1,512).—John Bennie.

London.—St. Pancras Borough Council. Four lifts at the Goldington Crescent housing scheme (£9,240).—Express Lift Co.

Metropolitan Water Board Works and Stores Committee. Recommended. Fixed-speed 11 kV a.c. induction motor, switchgear and ancillary equipment for use at the Board's Surbiton pumping station (£12,506).—Metropolitan-Vickers Electrical Co.

L.C.C. Electrical installations in The Laurels, Central Road, and blocks 1-4, Bishopsford Road, St. Helier estate, Morden (£3,244).—Archibald Saville & Co.

Maidstone.—Corporation. Recommended. Electrical installation work in five blocks of flats (Scheme 51A) on the Shepway estate (£2,661).—North Electrical & Refrigeration Co.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Ashton-under-Lyne.—Factory and offices, Junction Street; Dean & Whipp, Ltd., Clarendon Road.

Aylesbury.—Houses (161), shops and garages, Weedon Road extension; borough surveyor, Town Hall.

Barnstaple.—Houses (170), Zephyr estate; borough surveyor.

Basingstoke.—Houses (51), Hackwood Road area; M. Jones, town clerk, Municipal Buildings.

Bellingham.—Fire station (£21,000); county architect, Newcastle.

Berwick-on-Tweed.—Houses (100), on Spittal Hall estate; R. B. Davison, town clerk, Municipal Buildings.

Bingham.—Houses (201), on sites at Bingham, Keyworth and Shelton; R.D.C. surveyor, Council Offices, Market Place, Bingham, Notts.

Birmingham.—Warehouse and office block on site bounded by Lancaster Street, Lawson Street, Staniforth Street and Corporation Street (£750,000), for the Halford Cycle Co., Ltd., Gothic House, Henrietta Street, 19.

Boldon (Co. Durham).—Houses on five acres site at West Boldon; J. T. Edmondson, U.D.C. surveyor.

Brighton.—University college of Sussex at Stanmer Park (£1,000,000); D. J. Howe, borough surveyor, 26/30, King's Road.

Carlisle.—Houses (260), Morton estate; city engineer, 18, Fisher Street.

Chigwell.—Dwellings (43), as first section of development at Oakwood Hill, Loughton, for U.D.C.; Tooley and Foster, architects to Council, Midland Bank Chambers, Buckhurst Hill, Essex.

Coventry.—Research centre at Whitley; Sir W. G. Armstrong Whitworth Aircraft, Ltd.

Crewe.—Girls' secondary modern school, Gainsborough Street (£145,840); Cooper Bros. & John Clayton, builders, Catherine Street, Macclesfield.

Dagenham.—Dwellings (24), at Grantham Gardens, and (22) at Oxlow Lane/Rainham Road North; Keith Lauder, town clerk, Civic Centre.

Denshanger.—Secondary modern school; county architect, Northampton.

Derby.—Rebuilding (after fire) of Playhouse Theatre; Board of Management, Playhouse Theatre, Sacheveral Street.

Doncaster.—Development of 30-acre site at Wheatley Hall Road; Rockware Glass, Ltd., glass container manufacturers, Kirk Sandall, Doncaster.

Fawley (Southampton).—Synthetic rubber factory (£5,000,000), for the International Synthetic Rubber Co., Ltd.; Dunlop Rubber Co., Ltd., Fort Dunlop, Erdington, Birmingham, 24.

Gateshead.—Ten-storey flats (180 dwellings) in Ann Street; Wimpey and Co., Ltd., contractors, Orchard House, Newcastle-on-Tyne.

Glasgow.—Factory on site at Tannochside, for Caterpillar Tractor Co.; Wilson, Hamilton & Wilson, architects, Woodside Terrace, Charing Cross, Glasgow.

Harrow.—Self-service store, Harrow Coliseum site; Premier Supermarkets, Ltd., 15, Tavistock Place, W.C.1.

Hebburn.—Ambulance depot, Victoria Road East; county architect, South Street, Durham.

Hemel Hempstead.—R.C. church, Brickmakers Lane/St. Albans Road corner site; William Lacey (Hounslow), Ltd., builders, Hospital Road, Hounslow.

Hull.—Departmental store in Jamieson Street, including offices, dance hall, restaurant, etc., for the Co-operative Society, Ltd.; general manager and secretary, 254, Marlborough Avenue.

Leamington Spa.—Two blocks of multi-storey flats, Lillington estate; borough engineer.

Factory, Kingsway estate; Filton, Ltd., The Wharf, Clapham Street.

Leicester.—Demolition of Theatre Royal and erection on site of shops and offices; J. H. Lloyd Owen, city architect, 7, Newarke Street.

Grammar school at Birstall, and secondary modern school at Wigston; county architect, Leicester.

Letchworth.—Pig testing station, for the Ministry of Agriculture and Fisheries; Architect's Department, Ministry of Works, Abell House, John Islip Street, London, S.W.1.

Loftus (Yorks).—Church at Skinningrove; C. D. Taylor, architect, 41, Baxtergate, Whitby.

London.—Primary school, Hogarth Road, Chiswick; J. Lawson & Co., Ltd., builders, 28, Park Road North, W.3.

Factory, Hanbury Road, Stepney; Charles Owen & Co., Ltd., Royal Works, Coutts Road, E.3.

R.C. school, Streatham; David Stokes & Partners, architects, 5, Cochrane Street, N.W.8.

Eleven-storey block of flats, maisonnettes, shops, branch library, etc., as development of the Claremont estate, West Ham; borough architect, Town Hall, Stratford, E.15.

Longford.—County hospital; R. B. Higgins, consulting engineer, Church Street.

Minehead. — Orthoptic clinic, Minehead Hospital; South Western Regional Hospital Board, Tyndalls Park Road, Clifton, Bristol.

Newcastle-on-Tyne. — Joinery works and offices in Fisher Street; Universal Joinery Works, Huddlestone Road, Newcastle, 6.

New physics building at King's College; Basil Spence and Partners, architects, 48, Queen Anne Street, London, W.1.

Arts building for the Council of King's College; Leslie & Co., contractors, Woodlands Road, Darlington.

North Riding.—County school at Martin-in-Cleveland and Nunthorpe; primary school at Wilton; extensions to grammar school, Guisborough; central schools' kitchen, Strensall; and taxation offices, Northallerton; county architect, Northallerton.

Northumberland.—Child welfare centres at Forest Hall and Longbenton, and grammar school at Ashington (£218,000); county architect, County Hall, Newcastle-on-Tyne.

Orton.—Grammar school; county architect, Huntingdon.

Oxford.—Residential college (about 400 places) for University Authorities; clerk of works, 1a, Mansfield Road.

Penrith.—Old people's houses, Elm Terrace; F. Birbeck, U.D.C. surveyor.

Pickering.—School (£187,671); F. Shepherd & Sons, York.

Portsmouth.—Offices and stores at 38-40, Elm Grove; Norris Warming Co., Ltd., heating engineers, 18, Hampshire Terrace.

Purley.—C.D. administrative and training centre; J. Harrison, Surrey county architect, County Hall, Kingston-on-Thames.

Rotherham.—Flats (24), Broom Valley estate; Beeden, Ltd., builders, Thrybergh, near Rotherham.

Ryton-on-Tyne.—Swimming pool in the park; U.D.C. surveyor.

Sedgefield.—Houses (92) at Fishburn for the R.D.C.; R. J. Edwards & Co., builders, Foyle Street, Sunderland.

Houses (76) at Sedgefield and Trimdon Village for the R.D.C.; Bell & Ridley, Ltd., builders, North Road, Durham.

South Ockendon.—Two-storey ward block, General Hospital; North East Metropolitan Regional Hospital Board, 3, Queen Anne Street, London, W.1.

Sunderland.—Two old people's hostels (£38,000 each) and two secondary modern schools; borough architect.

Tynemouth.—Crematorium; borough surveyor.

Wantage.—Houses (54), in five parishes (£84,472), for R.D.C.; Selleck, Nicholls & Co., Ltd., builders, St. Austell.

Warminster.—Houses (76), Dene estate (£98,422), for U.D.C.; Holdoway & Sons, Ltd., builders, Upper Eden Vale Road, Westbury, Wilts.

Whittlesey.—Houses (110) on New Road estate; Gregory Houses, Ltd., Croydon, Surrey.

Wrexham.—Houses (86), Queen's Park estate; borough surveyor.

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to the dates stated:—

20th July

MARLEYTHENE. No. 747,500. Class 9. Electric conduit material and electric conduit fittings, all made of plastics.—Marley Tile Co., Ltd., London Road, Riverhead, Sevenoaks, Kent.

TERANEX. No. 749,752. Class 9. Insulated electric wire and electric cable.—British Thomson-Houston Co., Ltd., Crown House, Aldwych, London, W.C.2.

PROGRESS. No. B750,195. Class 9. Electric relays, electric switchgear and electric time registering apparatus.—M.T.E. Control Gear, Ltd., London Road, Leigh-on-Sea, Essex.

DELRAC. No. 751,082. Class 9. Scientific, nautical, surveying, navigating, optical, radio, radar, television, signalling, teaching and measuring apparatus and instruments; and electrical and electronic apparatus and instruments.—Decca Record Co., Ltd., 1 & 3, Brixton Road, London, S.W.9.

27th July

BRIDGE. No. 736,162. Class 7. Machines for use in the rubber and plastics industries and in the manufacture of electric cables, etc. —David Bridge & Co., Ltd., Castleton Ironworks, Queensway, Castleton, Rochdale, Lancs.

S.H. (design). No. B716,657. Class 7. Electrical machinery and parts. No. B716,658. Class 9. Electrical apparatus and instruments and parts. No. B716,659. Class 9. Electrically-operated surgical and medical apparatus. No. B716,660. Class 12. Electrically driven land vehicles, aircraft and watercraft, parts and fittings.—Siemens & Halske Akt.-Ges., Wittelsbacherplatz 4, Munich, Germany. Address for service, c/o Haseltine, Lake & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2.

OMEGA with letters RUI (design). No. 744,359. Class 9. Electric coffee percolators. —Francisco Urbe Irigoyen, Cafeteras Omega, Guipuzcoa, Spain. Address for service, c/o Lloyd Wise, Bouly & Haig, 10, New Court, Lincoln's Inn, London, W.C.2.

TRANSITROL. No. 750,881. Class 9. Instruments for measuring, indicating, recording and controlling temperatures, conductivity, hydrogen ion concentration, electric current, voltage, smoke, etc.; instruments for controlling and indicating failure in gas and electrical equipment; and electric control valves.—Ether, Ltd., Tyburn Road, Erdington, Birmingham, 24.

TREBAX. No. 752,337. Class 9. Loudspeakers.—Goodmans Industries, Ltd., Axiom Works, Lancelot Road, Wembley, Middx.

AQUALITE. No. 752,154. Class 11. Battery operated electric lights for attachment to lifebelts, lifejackets, etc.—McMurdo Instrument Co., Ltd., Victoria Works, Ashtead, Surrey.

LUMIPLEX. No. 752,453. Class 11. Lighting installations, parts and fittings—Holophane, Ltd., Holophane House, Elverton Street, Vincent Square, London, S.W.1.

MIRRLEES (design). No. 749,857. Class 12. Diesel engines for locomotives and parts.—Mirrlees, Bickerton & Day, Ltd., Mirrlees Works, off Bramhall Moor Lane, Hazel Grove, near Stockport.

SWEDEN'S OVERSEAS TRADE

Last year Sweden's electrical imports increased by 20 per cent to Kr.420·7 million while exports showed only a small advance at Kr.331 million (see *Electrical Review*, 29th June, page 1164). Except for generators, motors and convertors there were increases in most classes of imports and especially in cable and radio apparatus. Germany was the country's chief supplier, followed by the United Kingdom, which had less than a third of Germany's share. Details of both imports and exports, with increases compared with 1954, are given in the accompanying table. (Kr.14.50=£1.)

Class of Goods	IMPORTS		EXPORTS	
	1955 Kr. (000)	Inc. or dec. on 1954 Kr. (000)	1955 Kr. (000)	Inc. or dec. on 1954 Kr. (000)
Generators, motors, convertors, etc.	55,288	− 2,752	62,569	+ 2,513
Vacuum cleaners, fans, etc.	46,900	+ 5,319	47,610	+ 8,467
Stators, rotors, current collectors, etc.	9,986	+ 2,171	2,107	− 410
Accumulators	3,239	+ 126	14,854	− 3,431
Battery parts	4,133	− 273	—	—
Lamps, m.f.	9,576	+ 787	1,273	+ 334
Lamps, mercury vapour, etc.	17,595	+ 705	—	—
Carbons for electro-tech. purposes	15,550	+ 4,724	2,530*	− 1,852
Starting, regulating, control and switch apparatus	30,452	+ 2,502	21,495	+ 1,485
Porcelain insulators	4,179	+ 2,568	—	—
Cable, metalclad	31,355	+ 8,702	13,044	+ 3,206
Cable, other	19,990	+ 8,966		
Electric stoves, fires, etc.	4,737	+ 1,185	3,514	+ 655
Electric meters and instruments	13,775	+ 1,371	5,441	+ 2,271
Telegraph and telephone apparatus	5,397	+ 3,164	99,690	− 746
Radio apparatus and valves	55,877	+ 11,993	13,874	− 511
Röntgen tubes	2,552	+ 895	829	+ 296
Electro-medical, etc., apparatus and special elec.-tech. apparatus	90,634	+ 14,953	42,760	− 8,568
Other elec. machinery, etc.	11,630	+ 2,323	4,996	+ 919

* Includes lamp carbons and filaments.